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MICROCOMPUTING

for business . . . education . . . FUN!

PUBLISHER'S REMARKS

Wayne Green

That's me on the right talking about the St. Louis computerfest on the Channel 2 news. An Apple is being demonstrated on the left by Dennis Jolly of a local computer store.

No Blues in St. Louis

The St. Louis hamfest/computerfest, which I wrote about in this magazine, came to pass and was a giant success for all involved. I believe that they had the largest microcomputer audience I've ever addressed—well over 1500 in the big auditorium at the St. Louis Cervantes Center.

The exhibitors, many talked into coming via my "Microcomputing Industry Newsletter," all expressed delight over the attendance and the amount of money these people brought with them . . . and didn't take home. Over 3000 were registered at the gate, so the exhibit area was packed most of the time. What sold? What didn't? I don't think anyone brought enough software to meet the demand. Every computer exhibit was packed, constantly, with people waving money.

After this display of interest you may be sure that the 1980 St. Louis hamfest/computerfest is going to be a corker. Remember that this one was planned right at the last minute, with little notice to anyone except in *Kilobaud MICROCOMPUTING* and *73 Magazine*.

The whole thing started when Bob Heil (K9EID) called one day to ask what he had to do to get me to come out to the Marissa (IL) radio club and talk. I said all he had to do was put on a major hamfest and I'd be out. This was in December. A few weeks later he had all but one ham club in the area, plus all the computer clubs, lined up to cooperate; the rest is history. It doesn't take a lot of money or experience—all it takes is a lot of drive, which Bob Heil certainly has in spades.

Software Ideas

Since those interested in the stock market need timely information, this is a fertile market for the microcomputer.

There is a telephone-line service available from both the New York Stock Exchange and the American Exchange that will bring stock-market action to a home or business. The NYSE service is reported to cost under $150, and Amex is around $50 per month, including wire costs. All that is needed is a simple interface to your computer and the software to make it work.

You might want to have the immediate quotations running across the top of your screen and then be able to use the rest of the tube to look into memory for quotes on specific stocks. You might want the program to put aside quotations on stocks that are of interest for display on command. You might also want an automatic alert on certain price levels or changes in specific stocks.

Other exchange data, such as market volume, warrant actions and various indices, can be saved and accessed on demand.

How much would such a program earn for a programmer? It's early to tell, but my guess is at least $50,000 a year for two or three years in sales. It could well go to ten times that if a substantial percentage of the firms interested in the stock market went for it.

I suggest that only people familiar with the market get involved in a project such as this.

Other Market Data

A good program to help people interested in the commodity market would be another winner. This would want to access quotations as quickly as possible, chart the action, project probabilities and get input on as many significant factors as possible.

Warrant lovers might go for a special program to help them with their data and calculations . . . and so it goes. A lot of market-oriented programs that should sell well could be written.

Data Tapes

Eventually I think we'll be able to access the data we need, for a change, from what we might call data libraries or data banks. For instance, stockbrokers might want to get data on the minute-by-minute action in a stock over a period of years (who knows why?). Such data could then be accessed and paid for at a nominal fee. In the interim, as a way to lay the foundation for such a service, possibly over a cable TV line or telephone line—maybe even by direct satellite access—the data banks could start on a paying basis via cassette storage.

How many investors might prefer to have a daily or even weekly cassette with the ticker data? It might be sorted out and made easier to find what you want, but with the daily action available for computer manipulation.

Once something like that starts there will be a market, I think, for indexes for businessmen. Dentists need indexes for their literature. So do doctors and lawyers. Every professional man depends on recent magazine articles, books and technical papers. The problem is finding what you want when you need it. A data-bank system could do it.

Such a service, I'm sure, would interest Instant Software in marketing the data.

Price Lists

In every field is a serious need for updated price lists of products. This is required by dealers, many of whom have to keep large books of price data and make daily changes in pricing sheets. If someone gets a few days behind it can raise hell with things. In *73 Magazine*, Tufts Electronics tried for a couple of years to publish a current catalog of ham-equipment prices. But no matter how hard they tried, by the time the catalog was in the hands of the customers, a fair number of the retail prices had changed—seldom going lower.

A firm could grow considerably just by providing a weekly list of the latest prices for ham equipment, plumbing, automotive

Reader Responsibility

One of your responsibilites, as a reader of *Kilobaud MICROCOMPUTING*, is to aid and abet the increasing of circulation and advertising, both of which will bring you the same benefit: a larger and even better magazine. You can help by encouraging your friends to subscribe to *Kilobaud MICROCOMPUTING*. Remember: Subscriptions are guaranteed—money back if not delighted, so no one can lose. You can also help by tearing out one of the cards just inside the back cover and circling replies you'd like to see: catalogs, spec sheets, etc. Advertisers put a lot of trust in reader requests for information. To make it more worth your while to send in the card, a drawing will be held each month and the winner will get a lifetime subscription to *Kilobaud MICROCOMPUTING*!

This month's winner of a lifetime subscription to *Microcomputing* is Gary S. Fix of Alliance OH.

parts, etc. These could be stored on cassette for the time being—until some data-bank communications system develops. Yes, I know that there are services such as this in a few fields via microfiche. That's OK, except that you really need the information in a computer so you can access it in several ways and massage it however you want.

With a good program, you could follow the trends of any particular firm or product. It might even be able to tie in with an inventory program and update it for current prices by matching part numbers, thus giving you a more accurate current value for your inventory.

Telephone Program

A relatively simple sensor connected to your phone line could decipher the area code you are calling; have a lookup table for the phone rates to that area and a real-time clock to get the correct time-of-day rates; and then read out the dollars as they mount up for a phone call.

An extension of this program could keep track of the outgoing calls from all extensions of a business and print out a listing of the number called, extension used and cost of call.

If you design the hardware, we can have one of the *MICROCOMPUTING* advertisers put it into production to be marketed with the program as a package.

Phone List

There was a program in *Personal Computing*—a simple one—that allowed you to put in as data the name and phone number of people you would like to call. When you typed the name of the person, the program would print out the number.

I'd like to see a more sophisticated program that would go another step along that path. A hardware dialer or tone generator would be needed to interface the phone line. Then you could look up the phone number with the computer and give it the OK to call. On a busy signal it would report this and make the call for you later, with your OK.

I'd like to be able to call someone by company, by last name, perhaps have a cross-index of first names and even a listing by trade. Thus I might want to call the police, the doctor, Apple, Bill Godbout. . . .

Using up Your Tapes

I'm a registered skinflint. Even with thousands of perfectly good cassettes around me that I could use for program and data storage, I prefer to put as much as I can on a single cassette. Call me frugal.

This use of my cassettes has a drawback at first trial in that it can take a long time to find a particular program or data dump on a tape. There is a simple solution to this misery, if you think about it. Why not run the tape fast-forward to the segment you need? If you have a counter on your recorder you have no problem. For some reason all of our recorders with counters seem to end up in the Instant Software lab, and I'm usually stuck with an uncountered one. No big deal.

I made a quick chart of the rewind time vs the fast-forward time so I could tell how much time to run the tape at fast-forward to get to the place I needed. After each program or data dump on the tape, I keep the tape running for a few more seconds to leave a blank space that's easy to locate later. Then I rewind the tape to the beginning, watching the clock. By converting from rewind time to fast-forward time I can then determine just where to start my next dump. I mark most cassettes with the time in seconds of fast-forward for the start of each dump. It works every time and is simple.

With a little trick like this you can dump programs or data on the ends of most of your program cassettes. Why waste all that tape by just leaving it blank?

Yes, I know, when you change recorders, all those times go out the window.

Getting Rich

Would you truly like to be rich? Would you like to own your own plane, perhaps a yacht and maybe an Arabian horse? How about being able to travel anywhere in the world you want . . . perhaps a 30-room home on 50 acres with a fantastic view, your own fish pond and even an outside sauna? Fantasy? Not one bit of it. There are fortunes to be made in microcomputing if you go about it the right way. No matter what your education or intelligence, you can become a millionaire . . . if you really want to.

While the talks at computer shows on computer history, on bus structures, etc., usually attract small groups of interested listeners, my talks on how to make money in microcomputing usually pack the house.

Apprenticeship

I can't give you a crash course in just one editorial on how to get rich—this would leave too many questions open. However, I'll try to cover various aspects of the process over a series of editorials, with the end result being your enrichment.

One of the basics of being successful is to learn as much as you can on someone else's money. The failure to do this has much to do with the high failure rate of new businesses, even in microcomputing, which has been particularly forgiving. But how do you go out and get your first job so you can start learning with someone else paying for it?

Many people fall into that old Catch-22 situation where they have to have experience before they can get a job . . . but how are they going to get experience if they don't have a job? In the microcomputing field there is a simple way around this problem: start by getting your experience on your own microcomputer . . . and then help others with theirs. Computer-club and user-group attendance can be very helpful in your obtaining the experience

(continued on page 24)

About the Cover

All retail outlets of the Computer Store feature the Data General microNOVA computer for the small-business market. The microNOVA line is sold with a wide range of options in both computer and peripheral devices. Small-business customers of the Computer Store have Data General full field service and post-sales support available as well as professional, fully proven hardware and software. The Computer Store is Data General's largest distributor of the microNOVA line and the leading retailer of computer systems for small businesses in the Northeast. (Photo courtesy of Alan Ross, Total Communications, Inc., Newton MA, for the Computer Store of Burlington MA.)

kilobaud T.M.
MICROCOMPUTING

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OUTPUT FROM ISI

Sherry Smythe

First Gets Most

Every now and then I get a letter from a programmer who wants to limit the time that Instant Software can sell his program . . . who wants a different deal on royalties . . . who wants a special contract. For the edification of programmers, I'd like to explain a simple fact of life.

With over 1000 programs backed up for evaluation and publication at Instant Software, the natural course of events is to follow the path of least resistance and process those that present no problems. When an author has trouble signing a contract for some reason, when he wants some individual attention—this brings things to a stop . . . for that program. One of these days there will be enough staff to handle special cases and to answer questions and maybe even make individual deals.

Oh, I understand the plight of the programmer quite well. With sharks on every side looking to take advantage of programmers, they have to be very wary. I've seen case after case in which some outfit has conned a gullible programmer into giving up his work, only to get nothing for it. In this context, some of the user groups are real users.

But the programmer really has to put this into perspective. With relatively simple programs, ones that any good programmer could write in a couple of weeks or so, the odds are very high that dozens of these programs will be submitted to Instant Software. Only one of these will probably reach publication. This means that one programmer will hit the jackpot and the others will be holding a sack of nuts.

The jackpot programmer will not likely be one who has slowed or stopped work on his programs. The published programs will be from programmers who make our work the simplest by providing good documentation, flexible and easy-to-use programs, fast turnaround on communications and as few problems as possible.

The programmer has little to go on but our reputation. I will guarantee that Instant Software will try to do everything possible to treat all programmers well and make them a maximum of royalties. This is a fundamental rule for the whole organization, and it is a constant guideline. The long-range position of the firm relies on the goodwill of programmers and customers.

All programs published by Instant Software must be good, must be a good value and should be as simple to use as possible.

Associate Editors

More and more of the people who have submitted applications for program reviewing as associate editors have been hearing from us. I mentioned that back in December we put all the associate editors on file along with their systems and fields of expertise, only to have the North Star Horizon, complete with both the program and the data disks, stolen from the Instant Software lab.

The man who had written that program for us was back in school, so we had to wait for a new super-programmer to sign on. The new associate-editor program is now going on line, and this will greatly speed up the fielding of programs for evaluation.

We have received over 750 applications from people to review programs, so we'll be keeping a close eye out for outstanding work. The editor who takes too long with the evaluation, or who obviously hasn't put much serious thought into his work, gradually will be weeded out. I like to get a carefully considered review of a program, a suggestion on sales price and perhaps some ideas on improvement that can be discussed with the author. The editor who sits down and develops a program significantly will likely find himself sharing in the action to the extent of his contribution.

The speed of processing programs through Instant Software depends on the number of people on the staff. This, in turn, depends to some extent on the sales volume. We are now turning out well over one new package of programs per working day. This means that with an average of two programs per package and an acceptance of one in ten, we are able to process about 20 submitted programs per day. We're planning to expand that output to five packages per day, two programs per package on the average. We hope that one in three programs will be accepted as the quality of submitted programs increases . . . or a bit over 30 submissions per day processed.

The Instant Software staff is presently up to about 25 full-time employees and perhaps 20 part-timers. More help is needed for marketing, clerical work, package production, advertising, etc.

PET-POURRI

Len Lindsay

Hot News

Programmers and software companies: your worries about unauthorized copying of your programs are over. BC Computing (2124 Colorado Ave., Sun Prairie WI 53590) will protect your programs for you. I was fortunate to be able to spend an hour with the main PET programmer at BC Computing. Their system is impressive, and *it works*! Load a protected program by typing L-O-A-D [RETURN]. You will then be amazed to see the program LOAD and immediately run. If for some reason you manage to break out of the program (the STOP key does not work), the program will not list correctly and you lose control of your PET and have to turn it off and on again. A SAVE will not work; neither will the SYS equivalent!

Adding this protection is complex, so BC Computing charges a nominal fee for the service of protecting your program. Anyone marketing good PET programs now would be foolish not to have BC protect them.

Tapes

I have gone through almost 1000 cassettes now, and tested almost all brands and types. I have found one tape that is far superior to all the others for use on the PET (and other personal computers as well). These cassettes come from Computer Way and are "Agfa Premium" tape. Be careful of other companies advertising Agfa tapes—they have several different grades. "Agfa Premium" is the best. Just as important as the tape is the cassette housing. Make sure that it is a top-quality, screw-type housing, steel pins, flanged rollers and a hard window.

Computer Way sells only one kind of tape: the best. Since it has all the quality features I mentioned, all my programs and data are now recorded on their tapes. Their prices on Agfa Premium C-10 cassettes are lower than others advertised. Prices are:

- 25 at $1 each (total $25)
- 50 at 96¢ each (total $48)
- 100 at 85¢ each (total $85)
- 200 at 80¢ each (total $160)
- 400 at 75¢ each (total $300)

Approved computer clubs receive a ten percent discount on orders of 200 or more. Shipping and quick delivery anywhere in the USA are included, but boxes are extra.

Contact Computer Way, PO Box 7006, Madison WI 53707.

News

I have the light pen being sold by 3G Company (Rte. 3, Box 28A, Gaston OR 97119) for $29.95, and it does work. I had to turn up the brightness of my screen, though. The light pen plugs into your user port. With a small amount of software, the computer can "sense" where the pen is and react accordingly. I now will try to write some programs for

kids using a light pen. Please write with your applications or request information on what I have developed so far.

Commodore has now shipped PETs with expanded memory and hopes to have their peripherals out very soon. The ROM operating system in the new PETs is indeed different from that in the old PETs and is *not* compatible. Some programs written on older PETs may not function correctly on the new PETs.

The problems occur when PEEK, POKE, SYS or USR commands are used with locations that are different with the new ROMs, which supposedly correct all known flaws in the previous set. They are available only in the new PETs, but in the future they may be offered for sale separately.

Axiom (5932 San Fernando Rd., Glendale CA 91202) is now shipping electrostatic printers for $535 that simply plug into the PET IEEE port. They print uppercase and lowercase as well as full PET graphics. There is about a 16 week backlog of orders already. Also available is their electrostatic plotter for $895. It also simply plugs in and has the added feature of being able to print a graphic display from PET screen to paper. It doesn't leave a thin blank line between lines while in the plot mode. The plotter is available now; there are few back orders.

Recommendations

I want to put myself out on a limb and look at games commercially available for the PET. Many readers have written asking me to recommend games.

These serious, thinking games get my recommendation:

Microchess from Personal Software (PO Box 136-05, Cambridge MA 02138). Play a good game of chess against your PET for $19.95. Reviewed in the *Best of the PET Gazette*, p. 40.

Mastermind from *PET Gazette* (1929 Northport Dr., Room 6, Madison WI 53704). This is the best implementation of the game of Mastermind. Your PET can be either code-breaker or code-maker. The PET will almost always break your code faster than you can break its code. Cost is only $10 for Game Pak 1, which includes Mastermind and five other good games.

Maxit from Harry Saal (810 Garland Dr., Palo Alto CA 94303). This number-strategy game can be played either by two players or you vs the PET. Reviewed on p. 55 of the *Best of the PET Gazette*, Maxit costs only $4.95.

Othello from CMS Software (5115 Menefee, Dallas TX 75227). Reviewed in issue #7 of the *PET Gazette*, this is a good version of Othello. Price is $7.95.

Market from Dr. Daley (425 Grove Ave., Berrien Springs MI 49103). In this two-player game, each player manages his own company, including advertising budget, product prices and production. Your PET calculates how many units each person will sell for each quarter. Go broke and you lose. Invest $7.95 in this program.

I also recommend these classic computer games:

Star Trek is the all-time classic. Almost everyone is selling a version of it. I recommend these three sources:

Dr. Daley has several versions, some with sound effects, real time and other added extras . . . $7.95, or a super 16K version for $19.95. See its review on p. 84 of the *Best of the PET Gazette*.

Warren Swan (15933 Grove Ave., Oak Forest IL 60452) has a good real-time version for $20. It is reviewed on p. 28 of *PET Gazette*, issue #7.

Dad's Reliable Software (1614 Norman Way, Madison WI 53705) has a unique real-time version for $12.95 that is very challenging. It is reviewed on p. 84 of the *Best of the PET Gazette* and p. 28 of *PET Gazette*, issue #7.

Breakout is a standard video game. A good PET version with sound effects is available from CAP Electronics (1884 Shulman Ave., San Jose CA 95124) for only $4.95. It is reviewed on p. 26 of the *PET Gazette*, issue #7.

Kingdom is a simulation allowing you to attempt ruling a kingdom. Of the many versions available, my favorite is from Personal Software, Cambridge MA, for $14.95 (with three other programs): reviewed on p. 47 of the *Best of the PET Gazette*.

Block is a classic video game also known as Blockade, Snake and Wraptrap. ZZYP (2313 Morningside, Bryan TX 77801) has a good version for $9.95 (along with Football). It's reviewed on p. 87 of the *Best of the PET Gazette*.

Chase is a superb action game in which robots chase you around the screen. The best version I have seen is from *PET User Notes* (Box 371, Montgomeryville PA 18936).

There are a few unique games I can recommend.

Tanktics from Pleiades Game Co. (202 Faro Ave., Davis CA 95616) is a good tactical game that pits you against the PET. Fifteen dollars includes a game board, two-part program on cassette, game markers and manual. See pages 24 and 30 of *PET Gazette*, issue #7, for a review.

Two excellent fantasy games are Swordquest from Fantasy Games Software (PO Box 1683, Madison WI 53701), at $12.95 for tape and manual, and Devils Dungeon from Engel Enterprises (PO Box 16612, Tampa FL 33687), with listing and manual only. They're available on cassette from Jon Staebell (5102 Arrowhead Dr., Monona WI 53716). See their review on pages 66 and 67 of the *Best of the PET Gazette* and in the *Kilobaud MICROCOMPUTING* March 1979 PETpourri.

MAX from Tycom (68 Velma Ave., Pittsfield MA 01201) is a great dice game for $7.95. Also known as "lying dice," it is reviewed on pages 18 and 31 of *PET Gazette* issue #7.

Press-Up from Jamestown Small Computer Systems (2508 Valley Forge Dr., Madison WI 53719) is a fun, graphically illustrated game for kids as well as adults. Play against the PET or an opponent. Price is $7.95.

Periodicals

Looking for information on the PET? Here are my recommendations:

PET User Notes is $6 for 6 issues. Vol. 1, No. 7 was 16 pages; Vol. 2, No. 1 was 24 pages. Great for program listings and tidbits of information.

PET Gazette. The last two issues of this nonprofit magazine were each 36 pages. The *PET Gazette* has printed almost 200 PET product reviews already. Each issue also contains program listings, a complete list of PET companies and informative articles. Unbelievable as it may seem, the *PET Gazette* is a free publication. (Donations are gratefully accepted.)

Micro (PO Box 3, S. Chelmsford MA 01824) is a magazine for 6502-based computers, including the PET, Apple and KIM. It's $12 for 12 issues. Each issue is about 50 pages, and contains at least one or two good articles on the PET.

Recreational Computing (1263 El Camino Real, Box E, Menlo Park CA 94025) is the new name for the oldest personal computing magazine (formerly *People's Computers*). Price is $10 for one year of six issues. Besides the good information on computing for fun, each issue has information on the PET.

Books

Programming the 6502 by Rodnay Zaks from Sybex, $9.95, over 300 pages. This is a good book for any PET programmer wishing to learn machine language.

Best of the PET Gazette (1929 Northport Dr., Room 6, Madison WI 53704) is 100 pages of articles, reviews, program listings, resources and more, specifically for PET users . . . only $10 while they last.

PET User Manual from Commodore (901 California Ave., Palo Alto CA 94304) is $9.95 at dealers. If you already own a PET, get a copy by sending a photocopy of your proof of purchase, serial number and $3.50 to Commodore. Information from their previous tiny mini-manuals, plus some added information, is all contained in this one, bigger manual.

TIS Workbooks (PO Box 921, Los Alamos NM 87544) cost $4-$5 each. There are six different workbooks, each focusing on some specific area of PET programming.

Recommended PET Accessories

Keyboard—Skyles Electric Works (599 N. Mathilda Ave. #26, Sunnyvale CA 94086) has a full-size keyboard with numeric keypad that just plugs into the PET keyboard plug. Price is $125. It is reviewed in the *PET Gazette*, issue #7.

Joysticks—Coyote Enterprises (Box 101, Coyote CA 95013) has a well-designed connector that plugs into the user port. With two Atari joysticks and sample game programs, test program and programming-instruction programs, the cost is $50. Creative Software (PO Box 4030, Mountain View CA 94040) has a connector for the user port. With two joysticks and sample games the cost is $60.

Printers—Connecticut Microcomputer (150 Pocono Rd., Brookfield CT 06804) has a printer adapter (output RS-232) for $169. It should work with any RS-232 printer. I use it with a Teletype 43 and am pleased with it.

Sound—The best way to get sound output is to hook up your own speaker/amplifier using pins

(continued on page 12)

OHIO SCIENTIFIC'S SMALL SYSTEMS JOURNAL

Introduction to this month's journal

This month we will begin a multi-part series on Ohio Scientific's information management systems, OS-MDMS and OS-DMS. Ohio Scientific believes that data base managers and their subsequent information management systems are important keys to making microcomputers much more useful and generally accepted. They are also an important building block towards more sophisticated systems which demonstrate capabilities that we currently think of as being part of "artificial intelligence."

An Introduction to Microcomputer Information Management

Advanced applications of personal systems and small business computers utilize extensive data storage on disk. If one writes a few programs which utilize data storage, he quickly realizes that he is doing a lot of repetitive coding from program to program. Each program system which utilizes disk files must utilize routines that load the disk with information, routines that edit this information and routines that output the information. Commonly available DISK BASICS certainly provide the fundamental facilities for such operations, but in practice several lines of code are required for even the most rudimentary file handling routines. These routines expand greatly when sophisticated error checking and human engineering are incorporated into programs. Furthermore, in the process of developing programs the programmer may want to dump or list information in the files. As the programming system is refined over a period of months or years, it may be desirable to reorganize the information in the files. Therefore, the programmer typically develops file utilities. These may include a simple file dumper, some form of universal editor and file reorganizing facilities such as SORT, PACKER, etc.

Repetitive file handling and the need for utilities leads naturally to the concept of a data base management system. In its simplest form a data base management system is simply a convention or standardized format for disk usage. In conjunction with the standardized format several programs exist as part of the data base manager to support and maintain its format. These may include a standard editor, output routines, diagnostics such as file dumpers, utilities such as a SORT package and a library of standard subroutines which can be incorporated into user generated programs. Most, if not all, of these programs and subroutines will be typically generated in the standard upper level language of the operating system which on microcomputers would be BASIC and on large computers might be COBOL.

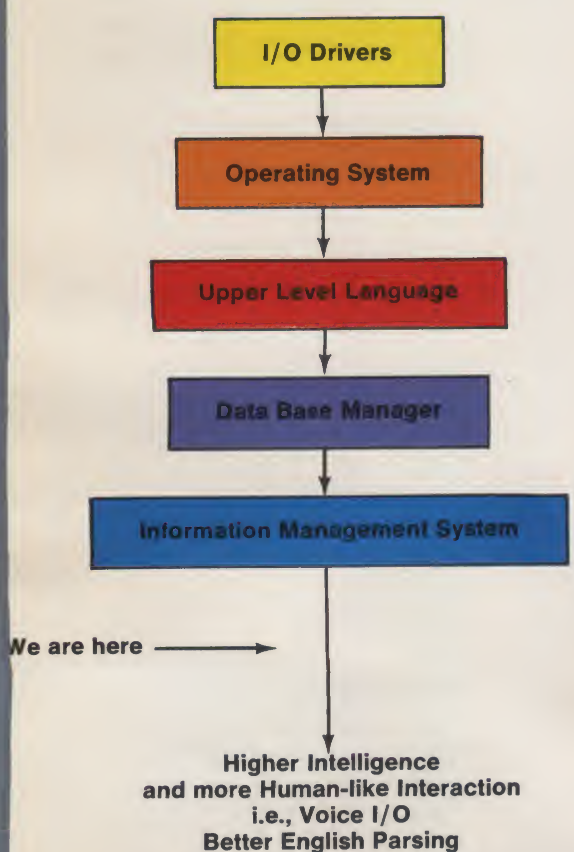
The immediate advantages of such an approach to file handling include the fundamental concept of standardized files which makes it possible for files generated and supported by one programming system to be used now and in the future by other programs. Standardization justifies the development of sophisticated diagnostics and utilities to aid further development of programs. Standardization along with the availability of sophisticated support programs make data base compatible software much easier to maintain than non-standardized programs. These concepts are all fundamentally part of the building block approach in which work is performed once and then used to build on as opposed to non-standardized approaches in which the same type of task is performed over and over. Thus, the data base approach inherently allows and justifies the development of more and more sophisticated software.

The disadvantage of the data base management system approach over conventionl non-standardized file handling is primarily that the programmer must learn the syntax of the DMS convention. That is, one must overcome the natural resistance to new ways of doing things. Furthermore, the necessarily more general purpose code for the data base manager is not as compact or as fast as the best specialized code which can be generated for a specific file structure for a specific application. However, both of these disadvantages can be minor if the data base management system is properly designed and are certainly outweighed by the tremendous advantages of modern data base management systems.

nformation Management Systems

The data base manager can be easily extended to nclude a stand alone package. If this package is carefully designed, it should be capable of handling a broad range of data file intensive applications without user programming. Instead of requiring programming, the information management system is to a simple degree adaptive, that is, the various modules of the information management system present the user with options which he selects. The system typically also accepts user defined syntax and incorporates it into data files and support programs. So n effect, traditional programming is replaced with a simple question and answer dialogue which specializes a generalized information system.

Evolution of Software Sophistication for Information Intensive Applications



Application's of Information Management on Microcomputer Systems

Home and Personal Computers

Floppy disk based personal computer systems are well suited to the storage of personal data in conjunction with a small concise information management system. Under a general purpose information manager telephone numbers, addresses, appointments, checking account transactions, savings account records, personal financial transactions and other data bases such as recipes can be directly "computerized" without any programming.

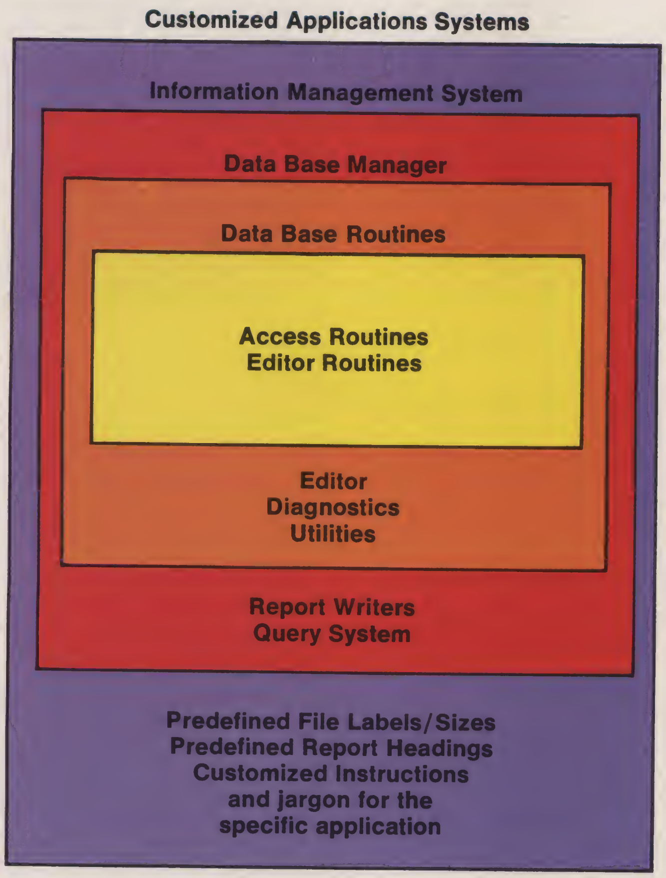
Many personal hobbies lend themselves to the information management approach including collections of information concerning the stock market, the value of coins and stamps and even sports records. These are all naturals for a well designed information management system approach without any user programming.

Small Business Applications

Information management systems have even a more profound impact in small business applications. The data base approach can be applied to traditional small computer business applications such as accounts receivable, accounts payable, cash receipts, disbursements and general ledger. The use of standardized formats and the general report writing and inquiry capability of information management systems allows this collective data base to be used for many managerial applications besides their primary application. However, the real impact on small business is in the application of an information management system on the primary information which concerns that business. For example, in a retailing/wholesaling operation inventory on hand, vendor lists and principal customers are all vitally important to the operation of the business. The storage and manipulation of these three data bases is a trivial matter for a well designed information system. Likewise, in real estate the home listings are crucial, in manufacturing, raw parts finished goods, vendors and customers are crucial. An auto dealer may require an inventory of new cars, used cars, parts, etc. Other applications include mailing lists, estimation packages and general client information for doctors, lawyers and service companies. In each case, the

business relies on collections of information which are easily computerized by information management systems effectively without any programming.

The Hierarchy of Microcomputer Information Management



With a well designed system the transition from a general information system to what "seems" to be a highly customized applications package requires only a short question answering session at the computer terminal.

Ohio Scientific Information Management Products

Ohio Scientific offers two information management systems — OS-MDMS and OS-DMS. These two systems have similarities but are designed for differe applications as outlined below.

OS-MDMS

OS-MDMS is designed to run on mini-floppy base personal computers, specifically the C2-4P serie and the C1P series mini-floppy computer system The system operates under OS-65D V3.0 disk ope ating system and runs in a minimum configuratio of 24K RAM in one 5¼″ mini-floppy disk. The syste is designed primarily for personal use in such area as checking and savings account maintenance, pe sonal calendar, etc. It has features comparable t competitive microcomputer data base manageme systems. The system features very high speed and very low system overhead. Although this system i designed primarily for mini-floppy, it can be utilize on 8″ floppy disk systems running OS-65D.

OS-DMS

OS-DMS is a highly sophisticated information ma agement system that is designed specifically fo Winchester disk based microcomputers. The syste is based on OS-65U and readily extendable to mult user and network systems under OS-65U Level II an Level III. The system directly supports single file up to 74 million bytes long. The system features ad vanced data structures and access routines whic minimize access time and maximally utilize availab disk storage for high levels of sophistication an "apparent intelligence." The system is also usabl on 8″ floppy based Ohio Scientific systems whic have 48K user partitions when running OS-65U.

The system is designed to be extendable to sup port areas that we commonly consider to be in th realm of "artificial intelligence." It can handle ger eral question and answering under a Query facilit and has provisions for extensions to include voic I/O capabilities as well as more elaborate Englis language parsing. In every way, OS-DMS is the ir formation management system of the future. It ca be installed on relatively small 48K 8″ floppy base computers and directly expanded to a 74 million byt Winchester disk system with multiple-users. In th future the same fundamental system will be ex tended to much more elaborate language parsin and human-like I/O. Thus, OS-DMS is already pre pared for the future when a typical $1000 compute will have a 20 megabyte storage capacity. The fo lowing section is a quick summary of the capabil ties of OS-DMS and OS-MDMS.

	OS-MDMS	OS-DMS
Base System	OS-65D V3.0	OS-65U Level 1, 2 or 3
Base Configuration	24K mini or 8″ floppy	48K 8″ floppy
Max. Configuration	48K 4-floppy system	Multi-user Winchester hard disk system with network communication
Data Structures	Entries Fields Records Files — (with key labels)	Entries Fields Records Master Files (with key labels) Key Files (Key, index pairs)
Access Types	Numeric by record and field Append Associative by specified field or general contents Conditional (<, =, >, <=, >=) to constant	Numeric by record and field Append Associative field or general contents Conditional (<, =, >, <=, >=) to constant Associative conditional as above to another field's contents ISAM by one of up to 8 key files per master file
Associative Access Technique	BASIC code Few hundred compares/sec	OS-65U "Find" command 250 Kbits/sec at 1 MHz 500 Kbits/sec at 2 MHz
Statistics Pack (All Access Types Apply)	Sum of a field Average of a field Sum of the products of two fields	Sum of N fields Average of N fields Min/max determination number of occurrences Sum of the products of N fields Standard deviation Variance
Data Base Programs	Create File Edit File File Dumper MDMS Directory Record Delete/Repack Repack SORT	Create File Edit File File Dumper DMS Directory Record Delete/Repack Record Inserter File Merge and Load SORT **Optional ISAM Facility** Key File Create Key File Edit Key File Load from Master Key File Sort
Information Management Programs	Statistical Analyzer Report Writer Single File Horizontal or Vertical Conditional Access Mailing Label Generator	Statistical Analyzer Single File Report Writer Horizontal or vertical Full Stat Pack Conditional and Associative Conditional Multi-File Report Writer Cross links up to 3 files by Associative Access and generates user specified report Mailing Label Generator Query System (Answers "general" questions)
Data Base Compatible Applications Systems	Checking Account Savings Account Personal Calendar Address/phone book Educational Testing System Mini A/R Mini Mailing List Mini Payroll Mini Inventory Mini A/P	Cash Receipts Cash Disbursements A/R A/P General Ledger Inventory/order entry Personnel/Payroll Estimation System Educational Testing System

In the next issue of the journal we will demonstrate many of the features of OS-DMS and OS-MDMS by typical application examples.

PET-POURRI

(from page 7)

M and N of the user port. This was explained in the February 1979 *Kilobaud MICROCOMPUTING* PET-pourri and in the *Best of the PET Gazette*.

Floppy Disks—I can't recommend any because I haven't yet seen any in operation with the PET.

```
READY.
     0 REM PI FIND REPLACE WITH 19 / 20
     1 NL=19:A=1999:REM NL=VALUE TO BE POKED-A=LAST MEMORY LOCATION TO SEARCH
     2 FOR X=1024 TO A:IF PEEK(X)=255 THEN POKE X,NL
     3 NEXT X
     4 POKE 525,5:PRINT "[CLR][ 2 DOWN]":FOR X=1 TO 4:POKE 526+X,13:PRINT X:NEXT X:PRINT "[HOME]":END

READY.
```

Program A.

List Protection

In the April 1979 PET-pourri I described a method of protecting *lines in any BASIC* program from being listed. Now I will explain another method, equally simple and easy to use, but which has different effects. As before, the best way to explain it is with some quick examples that you can type into your PET and see the effects.

While your PET is listing it still can execute some special functions if they are part of the line being listed and not in "quote mode." Special functions that can be executed during a LIST include:

- HOME CURSOR (19)
- DELETE (20)
- CURSOR RIGHT (29)
- CURSOR DOWN (17)

By POKEing the value of these functions (listed inside the parentheses) after a REMark you can include them at the end of your line. First put something, such as a π, in your listing after the REMark. Once the line is stored in memory you simply replace those values with the values of the special function you wish to be executed. Since a DELETE will erase the previous character in the listing, 20 DELETEs at the end of the line will erase the last 20 characters listed. Including the HOME function at the end of a line will cause the next line listed to start at the top of the screen.

As a quick example type in:

5 REM π

Now a normal LIST will list line 5 with a REM followed by a pi symbol. The value of that pi is stored in memory location 1030. Change it to a DELETE by entering:

POKE 1030,20

Now do a LIST and notice the line lists as:

5 RE

The M was deleted. Now add line 10 as follows:

10 REM THIS IS LISTED ON TOP

Now change the DELETE at 1030 to a HOME by:

POKE 1030,19

Now when you do a LIST, line 5 will list fine; then line 10 will list on the top of your screen. For fun you could put the HOME function at the end of every line. Your entire program will list on the second line of the screen. Here Program A will search for a pi symbol (value of 255) and change it to whatever you wish.

This program looks for a pi symbol and changes any it finds into whatever value you specify in line 1. When it is done it erases itself. Line 4 is the line that performs the self-erasing. Please write to me and let me know of any applications of this technique you may devise.

```
READY.

 10 FORL=832T0878:READX:POKEL,X:NEXTL
 20 REM SYS832 STOP DISABLE
 30 REM SYS845 STOP FUNCTIONAL AGAIN
 100 DATA120,169,99,141,25,2,169,3,141,26,2,88,96,120,169,133,141,25,2,169,230
 110 DATA141,26,2,88,96,169,0,72,72,72,72,76,133,230,32,90,3,234,169,255,141,9
 120 DATA2,76,126,230
READY.
```

Program B.

```
 10 PRINT"[CLR] TRACE  BY  BUTLER
 11 PRINT"MAY RUN SIMULTANEOUSLY WITH
 12 PRINT"A BASIC PROGRAM"
 13 PRINT"SYS(7868) TURNS TRACE ON"
 14 PRINT"SYS(7853) DISABLES TRACE"
 16 PRINT"HOLD SHIFT KEY DOWN TO SPEED IT UP
 18 PRINT"CHANGE TRACE SPEED WITH POKE 7972.X
 20 FORI= 7853 TO 8192 :READDC:POKEI.DC:NEXTI
 22 DATA162,5,189,181,224,149,194,202
 24 DATA16,248,169,239,133,210,96,169
 26 DATA172,133,134,169,30,133,135,169
 28 DATA255,133,124,160,0,162.3,134,125
 30 DATA162,3,32,239,30,208,249,202.208
 32 DATA248,32,239,30,32,239,30.162,5
 34 DATA189,249,31,149,194,202,16,248
 36 DATA169,242,133,210,76,106.197,230
 38 DATA124,208.2.230,125,177,124,96
 40 DATA230,201,208.2,230,202,96.32,197
 42 DATA0.8,72,133,79,138,72,152,72,166
 44 DATA137,165,136,197,77,208.4,228
 46 DATA78,240,107,133,77,133.82,134
 48 DATA78,134,83.173,4.2,208,14,169
 50 DATA3,133,74,202,208,253.136,208
 52 DATA250,198,74,16,246,32,201,31,169
 54 DATA160.160,80,153,255.127,136.208
 56 DATA250,132,76,132,84,132,85,132
 58 DATA86,120,248,160,15,6,82,38.83
 60 DATA162.253,181,87,117,87,149.87
 62 DATA232,48,247,136,16.238,216,88
 64 DATA162,2,169,48,133,89,134,88,181
 66 DATA84,72,74,74,74,74.32,211,31,104
 68 DATA41,15,32,211,31,166,88,202,16
 70 DATA233.32,217.31,32,217.31,165,75
 72 DATA197,201,240,55,165,79,208,4.133
 74 DATA77,240,47,16,42,201,255.208,8
 76 DATA169,94,32,225,31,24.144,33,41
 78 DATA127,170,160.0,185,145,192,48
 80 DATA3.200,208,248,200,202,16,244
 82 DATA185.145,192,48,6,32.223,31,200
 84 DATA208,245,41,127,32,223.31,165
 86 DATA201,133,75,104.168,104,170,104
 88 DATA40,96.168,173,64,232,41,32,208
 90 DATA249,152,96,9,48,197,89.208.4
 92 DATA169,32,208,2,198,89,41,63,9,128
 94 DATA132,81,32,201.31,164,76,153,0
 96 DATA128,192,79,208,2,160,7,200,132
 98 DATA76,164,81,96,76,255,30,32,248
 100 DATA30,55.32
READY.
```

BASIC program to POKE in correct values of Trace program.

Trace

Trace is a machine-language program that is designed to run at the same time as your BASIC program. Trace uses the top two lines of the PET video display. It continually lists the line number and command that the PET currently is executing. Your BASIC program continues to function normally.

In Trace's normal mode, your BASIC program is slowed down enough so that you can read each line as it is executed. Thus you can see when your program branches and gets caught in a loop.

Trace also has a FAST mode. Simply press the shift key. This allows you to quickly skip through sections of the program you know are functioning correctly. Trace is excellent for debugging your own programs. It also is very useful to help you understand someone else's program. You can watch the PET screen and see how the program is functioning at the same time.

Bret Butler did a superb job with this program. He has graciously placed it in the public domain. For your convenience, we have listed a BASIC program that POKEs in the correct values of the Trace machine-language program. It is well worth taking the time to type it into your PET. Hope you enjoy watching the PET execute two programs at once (Trace and your BASIC program).

STOP-Key Disable

Add the six lines in Program B to the beginning of your program. Then anytime in your program you wish to disable the STOP key, simply add the line:

(continued on page 25)

BOOKS

Personal Information Management Systems (PIMS)
Madan L. Gupta
Scelbi Pub., PO Box 133
Milford CT 06460, 87 pp., $9.95

If you have been in need of a good, versatile information-management system capable of sorting and listing and that will handle the addition, deletion and change of records consisting of a variable number of variable-length fields, you should seriously consider this package. It is a well-conceived, relatively efficient method of keeping track of myriad types of information. Its applications are limited only by the user's imagination.

As written, the program permits in-memory manipulation of up to 99 records, each consisting of up to ten fields of data. Records can be formatted any way you wish, limited only by Microsoft's BASIC maximum string length of 255 characters. The program requires about 8K of user memory; at least 16K is required for this package to be of any real use.

Unlike many application packages available these days, PIMS comes without a cassette tape of the program. A BASIC listing is given in the 87-page manual, and you must do the initial keyboarding of the program into your computer. Although the manual suggests that this process will require from two to three hours, it took me about an hour.

Since the package is written in BASIC, changes are more easily achieved than they would be if the program were provided in machine code. Customizing is thus within the reach of any computer owner with a working familiarity of the BASIC language.

When the program is first run, two operating modes are available: new-file creation and file load from cassette. Creation of a new file requires the definition of field names and type of data in each (whether alphanumeric or numeric) that is to make up each record of the new file. Up to ten fields, each with a four-character name, may be defined for each file.

Specifying a field name of more than four characters is OK, but the program truncates the name so that on subsequent display you see only the first four. For this reason, avoid field names that contain differences only beyond the fourth character (such as NAME1 and NAME2).

These field names and their type codes form the first record in your file; this record is used when the file later loads from tape to display the field names and types.

When field definition is complete, the program promptly displays (COMMAND)? and waits for your next operation. Replying with HELP results in a display of all the available commands: ADD, LIST, CHANGE, LABELS, HELP, END, SEARCH, SUM, SAVE, RUBOUT and SORT. To create a file initially, ADD puts you into the data-entry mode beginning with record 1, and displays, sequentially, each of the field names you originally specified. You simply respond to the prompting and enter data for your file.

When data entry is complete, entering STOP for the first field content places you back into the COMMAND mode from which you gain access to other features of the package.

The commands LIST, CHANGE, LABELS and RUBOUT each invoke a sub-mode that permits specifying whether you are processing *all* records, *one* record or a *range* of records (like the fifth through the tenth). LIST produces a screen list of all the specified records, including the name of the field and the data contained within. CHANGE permits the content of any field to be altered. RUBOUT deletes the record(s) from the file.

LABELS prints, without the field name, data from the first five fields of selected records. Thus, it is possible to carry data in addition to name, address, etc., in your records and still produce mailing labels with only data required for mailing.

SEARCH asks for a field number and the literal data to be used in comparison. Each record that satisfies the search constant is displayed, along with its record number. SUM permits the accumulation of a total from data within either all records or, in combination with the SEARCH function, in only those records that contain the specified data.

SORT permits the file to be sequenced according to information in any of the active fields. Sorting programs written in BASIC tend to be slow, and you notice it because nothing else is going on at the time. This sort is no exception. If you lean toward impatience, simply consider how long it would take you to do the equivalent job manually.

When you are finished with the file you are working, the SAVE command records it on tape for later use. When you are finished with the program, the END command takes you back to the BASIC interpreter, but not before reminding you to SAVE your data. This nice feature prevents inadvertent erasing of data accumulated during your session.

The first 67 pages of the PIMS manual are exhaustively complete. The first three chapters present a pleasant discussion of data management and possible uses of your home computer in a chatty, non-tutorial style . . . easy reading.

Chapter 4 discusses in detail each of the PIMS commands with examples and mentions a few tricks associated with their use.

In chapter 5, the author describes in detail 15 typical PIMS applications from building a mailing list to methods by which PIMS can be forced into being a tutor and giving tests. These last two applications, although workable, are a little difficult to manipulate; however, a few program modifications would make them excellent application areas for PIMS.

Chapter 6 contains the program listing in BASIC. The version presented will run "as is" (after you eliminate a few bugs discussed later) on Radio Shack's TRS-80. However, the author includes replacement code required for Commodore's PET and also discusses in general terms changes that may be required for support by other computers.

It is indeed unfortunate that a package as well conceived as this has to suffer from errors in the printed program listing—but it does, and seriously. A couple of the errors are sufficient to make the program useless as it is printed. But if you make the following changes to the program contained in the PIMS manual, your program will resemble the one that I have now been using for several weeks without problems.

1. Delete line 1900. This statement is apparently residue from a disk version . . . causes immediate problems in Level II TRS-80.

2. Line 990: change to: T$ = N$ + T$ + CHR$(126). As written, the statement causes each displayed field to be shifted one field number toward higher numbers; thus, whatever you enter against field 1 is located in field 2, and so on.

3. Line 1918: change to: IF T$ = F$ THEN GOTO 1950. As written, this statement will result in an empty file after reading from tape.

4. Line 2260: the 0 in this statement is not a zero; it is an alpha O.

5. Line 2450: change to GOTO 540. The program, as published, won't exit from the mode-solicit unless a valid input is received, so you have to rub out at least one record, even if you change your mind. This change returns control to the command solicit.

6. Line 3430: change to:

```
PRINT "ERROR ";ERR/2+1;" IN LINE "
;ERL
```

Error codes must be manipulated arithmetically to agree with their definitions in Radio Shack's *Level II BASIC Reference Manual*.

7. Line 1260: change to GOTO 540—otherwise, an attempt to SUM a file that contains only alphanumeric field types won't let you back into the command-solicit mode.

In addition to the above changes, two statements must be added in order to prevent residue from prior variable use from appearing in your data:

```
1675 T1$=" "
```

This statement will prevent data from a field change from appearing in a following field delete operation.

```
2065 FOR Z=1 TO 5:B$(Z)=" ":NEXT
```

This statement clears out the content of array B$ following a file load from tape; otherwise, producing labels from a file of rec-

```
2160 INPUT"FIELDS IN USE";Z$:IF LEFT$(Z$,1)="Y" THEN 440 ELSE RETURN
```

Fig. 1. Statement added to HELP routine.

ords that contains fewer than five fields results in residue from the file's description record being printed in the unused field positions.

I added an additional, helpful statement within the HELP routine that displays the field names currently in use (see Fig. 1).

Except for the bugs in the printed listing, which the above information should solve, this is a fine package, certainly worth $9.95. Contrary to the cover's claim, it hasn't done a thing for my "life-style," but it sure helps in information management.

Curtner B. Akin, Jr.
New London CT

Countdown
Robert Eisberg and Wendell Hyde
dilithium Press
Forest Grove OR
Softcover, $6.95, 1979

The cover of *Countdown* states that the book is concerned with skydiver, rocket and satellite motion on programmable calculators. My first reaction upon reading this was one of astonishment! How could anyone write more than half a dozen pages about simulating rocket and satellite motion on hand-held programmable calculators?

After reading more than 100 pages of text, my question was answered. When you cover everything from parachute drag to Kepler's laws, with a good introduction to conditional logic as well, it becomes difficult to write less than 100 pages!

Step-by-step instructions and, more important, step-by-step explanations are given for all the program examples. Full details are given for both Texas Instruments TI57 and Hewlett-Packard HP33E calculators, with the information needed to convert to the HP25 in a short appendix. With a bit of thought, you can modify all the programs to run on any programmable calculator that has similar functions to either the TI57 or HP33E. With a little more thought, you can use the flowcharts and program listings to develop programs in whatever brand of computerese you prefer—BASIC being an obvious candidate.

With all the Lunar Lander games being played on personal (and not so personal) systems, this book is a valuable source of both reference data and ideas. If Klingon battle cruisers obey the laws of physics from now on—in computer simulations—then this book may well be the reason!

All in all, if you ever get the urge to provide more realism in your simulations, this book is well worth investigating. The text is both clear and precise, with a sprinkling of humor. Both authors deserve a round of applause for an excellent book.

Jim Perry
***MICROCOMPUTING* staff**

The Little Book of BASIC Style
John M. Nevison
Addison-Wesley Publishing Co.
Reading MA 01867
Softcover, 151 pages, $5.95

Have you ever attempted to modify a computer program you wrote and had trouble recapturing the program's logic sequence or recognizing its array of variables? If so, you need the help this book provides.

A computer program is composed of code and comment, the author observes. Without code, the program cannot be read by the computer; without comment, the program cannot be read by a person. A programmer's comment clothes his program's code.

The book's subtitle, "How to Write a Program You Can Read," hints at the reward that awaits if you follow author Nevison's 19 simple rules of style. Most of the rules tell you how to indent program code and how to use blank lines to enhance program readability.

The Little Book of BASIC Style is, unquestionably, a "how to" manual, devoid of theoretical trappings. It should appeal to the computer hobbyist as well as to those who want to write good program documentation for small-business users.

Nevison's first rule, "Space symbols so that a line may be easily read," might strike you as self-evident. If the rule seems superfluous to you, compare examples of programs you are used to seeing printed in computer magazines with the well-spaced program lines that appear in the author's examples. Only then will you appreciate the need for reiterating the obvious.

Rule 10 states: "Tag variables and constants for quick reference." Few of us identify program variables (letter abbreviations whose values change) and are, therefore, doomed to reread our "cold" programs in their entirety before we are able to recapture the meanings we assigned to such symbols.

As Example 1 shows, using Nevison's rule 10 is simple.

```
160  REM        I....................THE HISTOGRAM INTERVAL
170  REM        J,K.............................INDEX VARIABLES
190  REM        X..........................A RANDOM NUMBER
```

Example 1.

Rule 18, "Exit carefully," contains a significant bit of advice: "When a GOTO statement exists, it should say precisely where it is going with an on-line comment." In other words, rather than using 180 GOTO 270, Nevison recommends using:

```
180  GOTO 270: REM          PRINT OUT
```

Hints on selecting variables suggested by the author include using the letters I, J and K as index-counting variables (a convention carried over from algebra), using the letters L, M and N for endpoints or loops and using letters that have meaning and, thereby, enhance recognition (for example, R for radius or C for circumference).

As a computer hobbyist, you might have a legitimate excuse for not adhering to all of Nevison's rules. Each blank line and space character used in a program to improve readability consumes memory that you might require to run your program.

But even if your computer has insufficient core memory to accommodate the comment you need to chart the program's direction, there is no reason why your hand-written draft of the program should not contain a full explanation and be retained for later review should you need it.

Nevison wisely ends his list of rules with these two unwritten rules: (1) follow the rules before you break them; (2) when there are good reasons, break the rules.

The Little Book is not merely easy to read; it is easy to reread. It presents programming hints simply and punctuates them amply with examples.

If you are looking for an inexpensive reference book to guide you in writing clear, concise computer programs, Nevison's style book is certain to fulfill your needs.

Sherman Wantz
Sebring FL

Computer Capers
Thomas Whiteside
T. Y. Crowell Co.
New York NY 10022
Hardcover, 164 pp., $7.95

On the subject of computer crime, two distinct categories of exposition have emerged: first, the technical studies directed at data-processing professionals, and second, the tabloid stories directed at computerphobics. *Computer Capers* is a thoughtfully written compromise. Although it is not the work of an industry insider (Whiteside is a staff writer for *The New Yorker*), it demonstrates a reasonable grasp of the new computer-crime phenomenon.

Most of the text is devoted to the presentation and analysis of factual but disguised case histories. Within the constraints of general-interest, nontechnical writing, Whiteside describes the techniques used in each case to penetrate the computer. His emphasis, however, is on the human side of the crime.

What motivates someone to steal through a computer? The most obvious reason is greed. Whiteside reports that a take of $1 million is considered "respectable but not extraordinary." But there are more subtle reasons: resentment against an underpaying, overworking position is by far the most common.

Appendix 2, "Computer-Related Crimes in Federal Programs," should be read and thoroughly digested by anyone involved in the implementation of business computers. A condensed version of a General Accounting Office report, it details the precautions that management should take to reduce the risk of a computer-abetted theft or embezzlement.

Computer Capers is a bit superficial at times. It has to be. No one could cover this topic adequately in 164 pages. The book is intended primarily for the interested layman rather than the sophisticated professional; it serves this purpose very well.

Numerous individuals, myself included, have written with consternation on the sloppy security practices common to most microcomputer systems. Perhaps this book will help enlighten those designers and businessmen who should know better.

David Price
Midlothian VA

(continued on page 25)

NEW PRODUCTS

Edited by Dennis Brisson

Bulls and Hits

Although it's called Bulls and Hits, this game cassette from the Computer Bus, PO Box 397B, Grand River OH 44045, is really Mastermind, using numbers instead of colors. It takes a bit of work to cope with the ten different numbers that can be used for each of the four spots instead of the five used by Mastermind. The action is the same and so is the logic.

Since I'm a Mastermind fan, I enjoyed this game. It didn't take long before I could guess the numbers in five or six tries.

For like-minded people there is a paperback book out that is packed with Mastermind games. I work a few every night to help put me to sleep . . . some of these games are easy, with my record being 8 seconds . . . some are a pain and kept me gnashing my teeth for 15 minutes.

Bulls and Hits is fun, but at $14.95 . . . whew! I checked with Instant Software as to how much they were going to charge for this type of game and found that there will be one very much like this coming out soon which will be about one-third of a $7.95 package of games. That seems more reasonable to me. I can see educational simulation games perhaps costing more than $8, but the run-of-the-mill games, particularly older ones, just don't seem right at the higher prices. This sort of pricing will get newcomers in the habit of stealing software by friendly exchanges, something we really want to get away from so we can get some good software written. It will only get written if there is a way to get paid for it. Reader Service number is C127.—Wayne.

CP/M-Compatible Micral C

Micral C is now compatible with the CP/M operating system, offering double-density minifloppy drives and an optional 10/80 megabyte disk system with removable media. The CP/M-compatible Micral C offers dynamic allocation of disk storage on floppies or hard disk, plus all the standard features of CP/M—the Save, Rename, Erase and Display Directories of Files commands, as well as editor, assembler and dynamic debugging programs. Also available are Microsoft Extended Disk BASIC, FORTRAN IV and COBOL.

The Micral C system.

The AQ8080Z.

With this system, you can effectively utilize 320K bytes of floppy-disk storage (standard) and up to 80 megabytes of optional hard-disk storage (up to four disk drives, each with a 10 megabyte fixed and/or 10 megabyte removable disk). Other software available includes an advanced business applications BASIC language (BAL) with a sequential and random access file management system.

The Micral C system with dual double-density floppies, 32K of RAM, a 1920 character uppercase/lowercase CRT display, keyboard and CP/M is $8995. The same system with a 10 megabyte disk is $15,950. Microsoft Extended Disk BASIC is $350; FORTRAN IV is $450; and COBOL is $675.

R2E of America, 47 Bedford St., SE, Minneapolis MN 55414. Reader Service number R30.

Z-80 Circuit Tester

The AQ8080Z Microprocessor Analyzer can now handle in-circuit testing of Z-80 systems, as well as 8080 and 8085 systems. Using three separate probes, the AQ8080Z now offers the safety and convenience of clip-on probe connections, direct user interaction with all memory locations and internal microprocessor registers and compatibility with all 8080, 8085 and Z-80 system configurations. As a cost-effective alternate to in-circuit emulators and CRT analyzers, the AQ8080Z needs no separate terminal, no memory allocation and no address or I/O port assignment.

The fully buffered probe clips directly to the microprocessor chip in the system being tested. The chip remains in its socket or can be soldered in. Since the microprocessor chip is never removed, the possibility of damage to the chip or socket is eliminated, and the microprocessor chip is tested along with other system components.

The interactive register access functions of the AQ8080Z include the Z-80's background (alternate) register set and index registers IX and IY. The user may examine or modify all memory locations and I/O ports and all internal 8080, 8085 and Z-80 registers, including the program counter and the stack pointer. The initial memory address may be specified by the front panel switch register or by the contents of any 16-bit internal register. Sequential access to the next memory location forward or backward is provided. Data may be transferred to or from any I/O port to help isolate faults in peripheral devices. The AQ8080Z is $2795.

AQ Systems, Inc., 1736 Front Street, Yorktown Heights NY 10598. Reader Service number A87.

Microcomputer Analyzer

The M68UCANA1 (110 V, 60 Hz) Microcomputer Analyzer (μCA) is a portable stand-alone test instrument for locating faults at the system, module and component level in 6800 microprocessor-based products. The lightweight attache-style case measures 19 inches wide by 10½ inches high, with a depth of 7½ inches. Weight is 21 pounds.

The microcomputer analyzer

Motorola's μCA.

The UPP-2700.

uses a microprocessor within the analyzer as the data generator, and the microprocessor socket of the system under test as the standard common test point for system analysis. The μCA is capable of fault diagnosis at all levels because it combines the power of two diagnostic techniques—in-circuit emulation (emulating microprocessor functions with an external device) and signature analysis (locating faults by probing test modes).

Several additional built-in features include: software control of both the alphanumeric display and the keyboard, which can be modified through program instructions, rather than hardware changes, and a multiple position card cage with space for additional modules such as memory, communications interface or other microprocessor emulators. Price is $3750.

Motorola Semiconductor Products, Inc., PO Box 20912, Phoenix AZ 85036. Reader Service number M20.

Production Duplicator

Oliver Advanced Engineering, Inc., 676 W. Wilson Ave., Glendale CA 91203, has a new production duplicator that combines both EPROM testing and programming in one unit. The UPP-2700 incorporates a unique circuit that evaluates all EPROMs both before and after programming. This circuit is designed to detect poorly erased or static-damaged EPROMs that might otherwise pass a verify test.

Simply press a single key, and the 8048 processor will test and duplicate sixteen 2708s in less than 200 seconds. A solid-state audio "beeper" will inform you of any incorrectly inserted devices or test failures. A 40-pin personality module contains the programming and test algorithms for a complete generic EPROM family. A complete system, including UPP-2700 duplicator, personality module and power supply, costs $2450. For medium or high production, a second duplicator ($1995) may be connected to the power supply to program 32 EPROMs simultaneously.

Five modules are currently available to program the following EPROMs: 2704, 2708, 27L08, TMS2716, I2758, I2716, TMS2516 and TMS 2532. Reader Service number O7.

Micropolis Software

Business and personal software packages for the Micropolis Mod II Disk System (48K RAM, 8080 and Z-80 CPU and Centronics 779 printer) are available from Small Business Computer Services, 813 MacArthur Dr., Urbana IL 61801.

The consumer software includes the investment pack, which includes options analysis, bond analysis, intrinsic value of stock (Molodovosky method) and a complete portfolio management system, and the family pack, which includes family/home budget analysis, mail and phone lists and tutorials in math and spelling. The packages are $35 each or $60 for both.

Business software includes: Accounts Receivable System—complete cash receipts journal, aged accounts receivable report, total sales report, sales and commissions—and the Accounts Payable System, which allows 20 invoices per vendor and features random access files; it prints a complete status of accounts, has satellite reports that document the accounts paid and directs the totals to the appropriate General Ledger Account. The price is $250 for both the accounts receivable and payable packages; if purchased separately, the cost is $150. Reader Service number S95.

Bubble-Memory Computers

The Findex line of microcomputers, combining the power of a central computer with the small size and portability of a terminal, features a sophisticated BASIC-language operating system; bubble-memory mass storage; uppercase and lowercase, alphanumeric plasma display; and integral printer.

The major model in the Findex line, System 128, incorporates 128K bytes magnetic bubble memory for mass storage. The bubble memory can be expanded in increments of 128K. This state-of-the-art data-storage technique offers high capacity in a small, stationary, lightweight package.

System 100 offers 90K bytes of mass storage in a mini-floppy disk housed inside the computer. The floppy storage can be expanded to 400K. Built-in memory in this system is the same as in System 128 and includes 48K bytes of dynamic RAM and 1K bytes of static RAM, expandable to over 2 megabytes, plus 8K bytes of ROM, expandable to 32K. External disk drives can be interfaced with the Findex to provide additional megabytes of mass storage.

Findex also contains serial, parallel I/O and S-100 capability for interfacing with a wide range of peripheral units. Findex uses a flat, gas plasma, display panel instead of the usual CRT. The scrolling display provides six rows of 40 dot-matrix uppercase and lowercase characters. The field of view can be scanned over any data base, making a large

Findex computer.

Super Grip II.

The Tone/80.

screen unnecessary for most applications. The Findex is programmed in Business BASIC but also supports a FORTRAN and COBOL compiler. Systems are priced from less than $5000.

Findex, Inc., 1625 West Olympic Boulevard, Suite 707, Los Angeles CA 90015. Reader Service number F16.

Test Clip/IC Puller

Now you can readily test ICs with as little as 0.040 inch between opposing legs with the Super Grip II, a new test clip that features a narrower nose clearance, which easily attaches to high-density boards. The new "duck bill" contour of the contact tips provides more secure contact with DIP ICs. Super Grip II provides positive, reliable, no-shorting connections every time.

A new pin design keeps test probes where they belong: Offset pin rows make it easier to attach test probes. "Button heads" on the ends of the pins prevent probes from sliding off once they're in place.

Heavy-duty springs apply firm contact pressure for testing, hefty grip when pulling ICs. Industrial-grade nylon forms the test clip body and is integrally molded around contact pins and the steel pivot pin in the unit's hinge. Test clips are available in 8, 14, 16, 16 LSI, 18, 20, 22, 24, 28, 36 and 40 pin configurations.

A P Products, Inc., Painesville OH. Reader Service number A22.

TRS-80 Tone Generator

TRS-80 owners can now create sound effects for games, compose musical tunes or add sound to a burglar alarm with the Telesis Tone/80 Programmable Tone Generator. Designed for the Level II system, the Tone/80 responds to output commands from the TRS-80 and can produce 128 different tones.

No additional interfacing with the TRS-80 is required (it can be used with the TRS-80 expansion interface). Tone/80 is equipped with approximately 2 inches of ribbon cable with mating connector and can be plugged into either the TRS-80 keyboard module or the screen printer port on the expansion interface.

Completely assembled and tested, Tone/80 comes with a data and applications package that includes software for producing whistles, sirens, phasor sounds and even a few tunes and also includes notes on how to add various sounds to your favorite computer games. Cost is $89.95.

Telesis Laboratory, Peripherals Division, PO Box 1843, Chillicothe OH 45601. Reader Service number T51.

Digital Multimeter

The LX 303 is a 3½-digit pocket-sized digital multimeter for electrical/electronic test, calibration and field service applications. The LX 303 features auto-polarity, auto-zero and automatic overage indication and a large 1/2 inch angle mounted LCD readout for high readability indoors and out, even in bright sunlight. A reading rate of three readings per second makes accurate reading fast and convenient. Battery life is 200 hours minimum (300 hours typical) from a single 9 V alkaline battery. Handy battery check capability is also provided.

Lightweight (12 oz.) and compact (5 7/8 × 3 3/8 × 1 3/4 inches), the LX 303 uses LSI circuitry and laser-trimmed thin-film resistor networks for low parts count. The overload characteristics provide 1000 volt protection on all dc voltage ranges except the 200 mV range, which is protected to 500 V. All ac ranges are protected to 600 V. All Ohm ranges are protected to 120 V. Maintainability is also excellent due to the use of sockets for the major components, including the display, and the extensive use of standard components. The unit is covered by a 1 year warranty. Price is $74.95.

The Hickok Electrical Instrument Company, 10514 Dupont Ave., Cleveland OH 44108. Reader Service number H35.

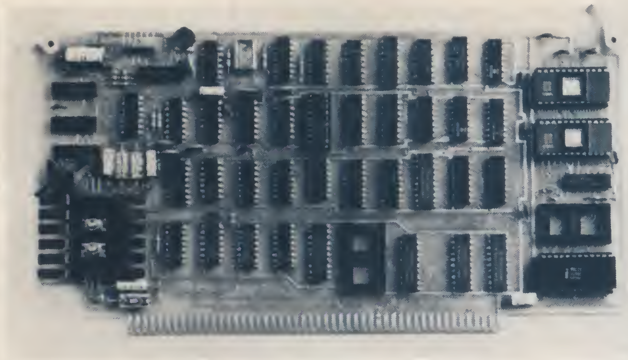
Studio II Converter

The information you've been waiting for on how to convert the RCA Studio II video game into a simple microcomputer (see New Products, *Microcomputing*, February 1979, p. 12) is now available from ARESCO, PO Box 43, Audubon PA 19407. The information package describes how to construct a new cartridge for the Studio II and includes schematics, ROM monitor listing, operating instructions and program listings. ARESCO also offers a printed circuit board and preprogrammed PROM containing the conversion program, as well as a fully assembled and tested cartridge.

No modifications to the Studio II are required. With the new cartridge, you simply enter machine-language programs through the keypads, and the programs can be controlled from the keypads and generate TV displays on a standard TV attached to the Studio II. The converted Studio II contains 512 bytes of RAM, 256 bytes of ROM, an RCA COSMAC 1802 microprocessor, a video graphics interface, an FCC-approved rf modulator, two 10-key keypads and a processor-controlled beeper.

The information package costs $5. Reader Service number A86.

The LX 303.



Flashwriter II.

Double-Density Floppies

A new double-density floppy disk drive by Micro-Peripherals, Inc. (MPI), 21201 Oxnard St., Woodland Hills CA 91367, comes in two versions: Model B51 is single-sided, storing up to 250K bytes of data on one side of a 5.25-inch diskette. Model B52 reads/writes on both sides of the diskette, giving direct access to 500K bytes.

An automatic diskette positioning and ejector mechanism in the models pre-positions the diskette over the spindle hub before the clutch-centering device is engaged. This facilitates precise alignment of the diskette for operation. The mechanism also partially ejects the diskette when the door is opened, making diskette removal quick and easy.

A band head-positioning device reduces track-to-track access time to 5 milliseconds. In this development the stepper motor turns a precision pulley, built to tolerances of .0001 inch, which moves the recording head forward or backward to a track. A proprietary metal band assures years of trouble-free operation without loss of positioning accuracy.

Both models of floppy disk drives will accommodate FM, MFM, M²FM or GCR encoding techniques. Reader Service number M14.

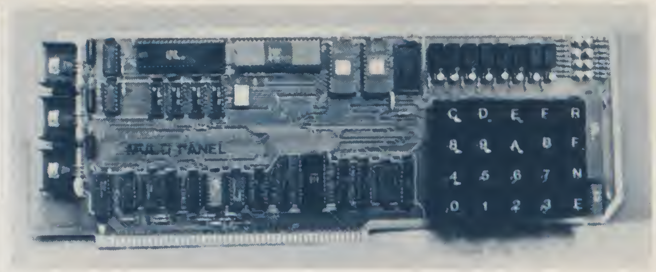
MPI flexible disk drive.

High Density/Reverse Video Board

The Flashwriter II video board displays 80 characters × 24 lines and uses an 8 × 10 dot matrix to produce sharp resolution for 1920 character positions in a 2048 byte memory block. In addition to normal video, reverse video is optionally controlled by the higher-order bit of the character code. As many as 256 characters can be generated by 2708/2716 EPROMs, which may be user-programmed for special symbols or graphic displays.

The Flashwriter II allows rapid updating of the screen via memory-mapped I/O. Special circuitry prevents flashes on the screen when updating memory, and a keyboard port with latched data provides easy interface to other parallel keyboards. Price is $320, assembled.

Vector Graphic, Inc., 31364 Via Colinas, Westlake Village CA 91361. Reader Service number V10.



INMOD-885.

S-100 Processor/Console

The INMOD-885 is an S-100 processor/console board with integral CPU and console functions. It features a 3 MHz 8085A CPU, versatile EPROM monitor, 20-digit keyboard and 8-digit prompting hex display.

The 8085A CPU executes all 8080 programs at 50 percent faster speed than other S-100 CPU boards even though the system chip count and power supply requirements are reduced. The hex keyboard/displays increase speed and versatility in programming and debugging. The prompting hex displays reduce the chance of error in reading or entering data, and the clear hex console keyboard reduces the chance of conversion error in program entry.

The conversational monitor provides usual I/O functions plus memory protect/unprotect and two powerful debugging aids. The unit, assembled and tested, costs $399.

Industrial Modules, Inc., PO Box 2985, Santa Clara CA 95051. Reader Service number I37.

Flat Cable Guide

Bonded and laminated flat cable, bulk and prestripped flat jumper cable and custom cable assemblies are described in a new 8-page guide published by Belden Corp.'s Electronic Division. The publication, No. ED79-1, describes the space-, weight- and cost-saving benefits of Belden's UL-recognized flat cable for multi-point interconnection applications. Specifications and technical data are presented for 26 bonded constructions, rated at 80° C/300 V, with 10 to 30 round conductors.

Belden's cable guide.

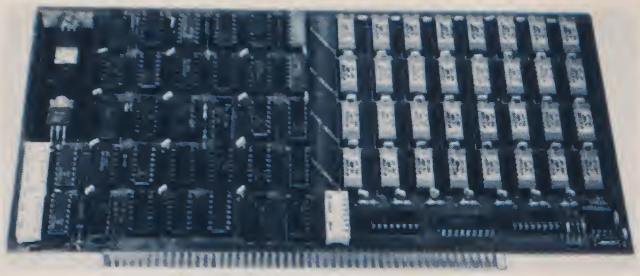
The illustrated booklet also describes new bulk and stripped-to-length flat jumper cable with 3 to 36 conductors at 0.100 inch spacing and Belden's custom cable-connector assembly and harness capabilities. Ordering information keyed to Uniform Product Code designations is included for standard constructions, along with a special chart that aids specification of custom jumper cable designs.

Belden Corp., Marketing Communications, 2000 S. Batavia Ave., Geneva IL 60134. Reader Service number B41.

S-100 Serial Port

ESP+ is an eight, full-duplex serial board for the S-100 bus. It is the first of three boards and associated license software to comprise a data communications subsystem available from Trace Electronics, Inc., 570 West DeKalb Pike, King of Prussia PA 19406.

The ESP+ provides memory-bank switching, two (or one, if bank switching is used) 8-bit bidirectional parallel ports, an 8-bit sense switch and three 16-bit counters, which may be used independently or in tandem for interval interrupt and nonstandard baud rate generation. Each port may run at any of nine baud rates from 110 to 9600. All lines present one LS load to the bus. Inter-



The CI-S100.

rupt modes are provided for each counter, serial port and parallel port.

Three additional cost options are available:

- a six-digit time of day clock accessible through the ESP+.
- a modem controller to handle incoming lines from up to eight modems.
- a software baud rate controller to select the baud rate for each serial port independently.

The ESP+ is $895, assembled and tested. Reader Service number T60.

64K Byte Memory

The CI-S100 is designed to plug directly into the memory slots of most S-100 microcomputers. The dynamic RAM memory module requires no wait states at 2 or 4 MHz and is compatible with most S-100 bus microcomputers, including the Z-80 at 4 MHz.

The CI-S100 includes expandability to a half megabyte with a bank-select feature, which allows you to select up to eight 64K byte memory cards. On-board hidden refresh requires no outside intervention, making the CI-S100 look like a static RAM to the outside world, even during block DMA write applications.

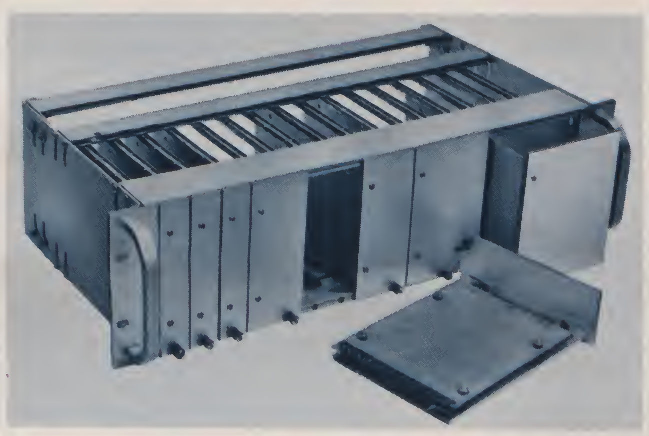
The 5×10 inches memory module is addressable in 4K increments up to 512 bytes of memory. It is available with battery backup capability. Price is $695.

Chrislin Industries, Inc., 31312 Via Colinas #102, Westlake Village CA 91361. Reader Service number C125.

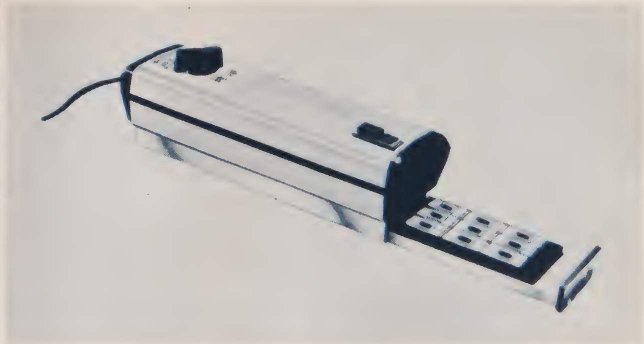
Universal Card Cages

The CCM 13 (5.25×9 inches) and the CCM 14 (3.5, 5.25, 7 or 8.75×9 or 12 inches) series cages give designers a choice of compatible 19-inch rack-mounted enclosures with four heights and two depths. Thirty-two individual aluminum L-shaped cardmount modules of various heights, widths and lengths accommodate virtually all standard and many special card sizes.

The universal card-cage system features heavy-duty aluminum side walls joined by rigid extruded channels and slots in the side walls and mounting brackets that permit four-way connector adjustment—up, down, forward and backward. The cages' card-guides, on one-inch centers, permit installation of up to 16, one-inch cardmounts or any similar combination utilizing one-inch, two-inch, three-inch or four-inch wide modules. Captive nuts in the rear extrusions allow receptacle mounting with any spacing. The cages also accept motherboards for rear-panel interconnections.



The CCM 14.



The PE-24T.

In under ten quantities the CCM 13 card cages range from $54.22 to $135.03, and the CCM 14 card cages range from $50.04 to $75.00, depending on size. Cardmount modules must be ordered separately, except for the CCM 13 series, and range from $5.01 to $8.50 (1-49), depending upon the size.

Vector Electronic Company, 12460 Galdstone Ave., Sylmar CA 91342. Reader Service number V8.

EPROM Eraser

The PE-24T is a new EPROM erase lamp that includes a pair of ultraviolet-emitting glass tubes. Weighing only 3 lbs., it is intended for the bench or engineering lab and gives big-lamp results at a much lower cost. A conductive-foam pad holds up to nine EPROMs at the correct distance and exposure angle to assure fast and complete erasure of today's largest EPROMs.

Operator safety and convenience are provided by a slide-out tray that has a blue viewport and automatically shuts the lamp off if opened during operation. The built-in timer can be preset for automatic shutoff times of up to one hour. Price is $114.50.

Adco Electronics, 2182 DuPont, Suite 222, Irvine CA 92715. Reader Service number A85.

Compose II

Compose II, a new report generation software package designed for Data General end users, is written in Business BASIC and is designed to operate under DG's RDOS operating system. Based upon the original Compose package, the enhanced software provides even greater value to users, who can now benefit from advanced refinements.

Reports can be custom-designed, formatted and produced by answering a set of video-displayed questions and require no programming knowledge or previous computer experience to generate. Secondary files can be accessed to retrieve related data for inclusion, and an existing index permits definition of the selection and sort in order to speed processing.

Compose II allows 16 columns, up from nine previously provided, and incorporates a test for any column to determine whether a specific print line should be included. Price is $3000.

Compusource Corp., 21735 S. Western Ave., Torrance CA 90501. Reader Service number C126.

Zilog Data Book

Zilog, Inc., announces the *Zilog Data Book*, the first compilation of detailed specifications for the firm's components, boards and development systems. The 132-page book is aimed at design engineers who will use Zilog products in constructing their own microcomputer systems. It includes sections on the Z-80 family of MOS LSI microcomputer components, Zilog memory components, the MCB series of microcomputer board products and the ZDS-1 series of microcomputer development systems.

Each of the *Data Book's* three major sections begins with an introductory description of that category's significant features. The catalog also contains a list of Zilog's regional offices and an order form for additional Zilog literature. Cost is $5.

Zilog Literature Dept., 10340 Bubb Rd., Cupertino CA 95014. Reader Service number Z3.

It's already a big success!

The party's over for all dumb terminals and a lot of smart ones too. But, at $798 (quantity 25), the party's just beginning for Intertec's InterTube II.

Standard features to celebrate include a full 24 line by 80 character display, 128 upper and lower case ASCII characters, reverse video, complete cursor addressing and control, an 18 key numeric keypad, special function keys, blinking, protected fields, character and line insert/delete, editing, eleven special graphics symbols, a 25th status line which displays the terminal operating mode and an RS-232 printer port.

You'll discover even more reasons to celebrate when you sit down in front of an InterTube II. Our wide bandwidth monitor produces crisp, sharp chararters everywhere on the screen. InterTube's Z-80 processor enables a host of operator oriented features to boost the efficiency of both software and programmers. And, InterTube's rugged modular design combined with its built-in self-test mode insures quick and reliable servicing.

InterTube's price/performance ratio can satisfy your requirements whether they be a sophisticated data entry application or a simple inquiry/response environment. So, there's really no reason to think "dumb" when you can afford to be so smart!

Join the thousands of InterTube celebrations going on around the country at this very moment. Call us at the number below and start your own celebration (BYOB—we'll bring the InterTube).

INTERTEC DATA SYSTEMS®

2300 Broad River Road, Columbia, S. C. 29210
(803) 798-9100 TWX: 810-666-2115

* $995 Quantity One

COMPUTER CLINIC

I am using the "(Con)text Editor" program described in the September 1978 issue of *Kilobaud* with my Level II TRS-80 and an elderly Model 15 TTY. I am pleased with the program, except for one thing: no commas or colons allowed. The author cures this problem for Mits 8K BASIC 4.0 by poking a 34 into locations 2507 and 2509 early in the program, and then restoring a 58 and 44 to those locations before the user leaves the editor. Does anyone know the secret locations for the same things in TRS-80 Level II BASIC? If so, I would appreciate their getting in touch with me.

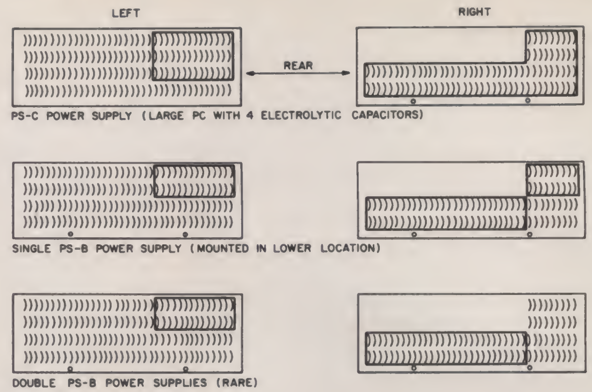
Louise H. Frankenberg
1289 Magothy Rd.
Pasadena MD 21122

I have just received a "Nibbler I" microcomputer (SC/MP II with 4K NIBL BASIC in ROM and 2K RAM), to which I intend adding 6K more RAM. I would be pleased to communicate with anyone who is using this unit with a view to exchanging information on the expansion, use and programming of this tiny system. I request that any *direct* postal communication to Australia be via *air mail*, as the 3-month-plus delay of surface mail makes for v-e-r-y extended communications.

Graham Gaiger
50, Armour Way
Lesmurdie 6076
Western Australia

Some have encountered forced-air cooling problems with Imsai's I-8080 series of microcomputers. The problem stems from improperly designed air-inlet slots. Cooling efficiency is compromised by excess slots on the cover and a poorly placed power transformer.

Cooling can be considerably improved by blocking certain cooling slots, thus balancing the air flow through the chassis. Just match the power-supply combination installed in your computer with the descriptions above and cover the slots accordingly. Duct tape may be used to effect these alterations. All panel views are from the inside of the cover.



Michael J. Friese
PO Box 17296
Irvine CA 92713

Our Washington office needs help in locating teachers for computer science and electronics.

The Department of Defense Dependents Schools, serving the children of US military and civilian support personnel throughout much of the world, are in need of computer-science teachers and electronic-training instructors. Thirty-eight computer systems are available to the instructional program, with BASIC being the most commonly used language.

Qualification requirements: A minimum of nine semester hours in computer science plus sufficient additional course work to qualify as a teacher in another subject.

For full information, call Mr. Francisco or Ms. Wycoff at (202) 325-0690 or write to the address below for an employment application.

Samuel W. Calvin
Coordinator,
Computer Education
DOD Dependents Schools
2461 Eisenhower Ave.
Alexandria VA 22331

LETTERS

Hail Heath

Ron Rocheleau's fine article on the Heath Disk System (April 1979, p. 30) covered the main points of this first-rate disk operating system, but Ron omitted some of the more subtle features. For instance, the controller-board ROM contains a memory-test routine called up from the H8's front panel that tests both its own and the H8's RAM. Another useful technique is the use of the Peripheral Interchange Program (PIP) to concatenate files or programs, usable with one disk drive or two.

Ron mentioned the SET feature, which allows, among other things, the setting of drive seek time. The manuals indicate that seek times down to eight msec. can be set, but I have found that five out of six drives I've seen will in fact go to six msec. The drives are extremely reliable; in nine months of nearly full-time use, neither has shown a hint of a problem.

One of the greatest advantages of a disk system comes from the ease of creating assembly-language programs. Always a tedious process with the standard two-pass tape assemblers, the disk makes this chore fun. Heath's editor is optimized for this function, not for word processing (but the Heath Users' Group has a disk-based character-oriented editor available for $16.50). Until you've used a disk to create an assembly-language program, you won't appreciate the true value of the system.

Also worth noting: Heath has just released a version of Microsoft's BASIC with formatted print statement and double precision ($100) and Microsoft's disk FORTRAN ($150), both real bargains, with business-oriented software packages available in June. Furthermore, Lifeboat Associates' Tony Gold has announced the impending release of CP/M for the H8, which will allow use of all sorts of specialized ready-to-run software.

Happy with Heath? I should say so. They've been around for a great many years, and their support is the industry's standard. I can only echo Ron: Compare system-for-system, and you'll go with Heath, too.

D. C. Shoemaker
Leavenworth KS

Dot Dot Dot

The first (and only) response to my challenge ("The 1802 is the most powerful 8-bit micro") arrived in my mailbox before the February issue of *Kilobaud MICROCOMPUTING*, in which the challenge was printed. You can imagine, then, my astonishment to find that Mike Amling had beaten my code not by 10 percent but by over 30 percent! Aside from a few inconsequential bugs in his code, he did meet the requirements. Therefore, I did award him his $50 (ouch!) prize, though rather reluctantly. I say reluctantly, because he used another way of organizing his tables than I did. As soon as I saw what he had done, I revised my program along the same lines and beat his code by another 0.2 percent.

What Mike proved, then, was not the superiority of the Z-80 over the 1802, but the superiority of his cleverness over mine. I will have to concede, however, that the Z-80 fared no worse in the contest. I have to infer from the lack of large numbers of entries that none of the other micros came anywhere near.

Let me suggest an alternative version of my claim: All the 65K-8-bit microprocessors have about

the same power (measured in bytes*memcycles), so you might as well pick yours for other reasons, such as available software (Z-80/8080) or buy-in price (6502 or 1802) or low power (1802) or the phase of the moon. I still think the 1802 has a cleaner architecture. It is a great pity that the folks at RCA who make it (and even the guy who designed it!) do not understand its fine qualities well enough to promote the 1802 adequately against the 8080 family.

Tom Pittman
San Jose CA

Purrs over PET-pourri

Just a note to let you know how much I appreciate Len Lindsay's "PET-pourri" column in your magazine. As an owner of the notoriously undocumented PET machine (which I think is a wonderful piece of hardware), I have found the column to be almost invaluable. I sincerely hope you encourage Mr. Lindsay to keep it up, and that you continue to publish it, notwithstanding grumblings from TRS-80 owners, etc. I entirely agree with your editorial comment in the March 1979 issue that the column is justified by the lack of information from Commodore. Of course I am prejudiced.

In any event, I think the column has a good balance between software and hardware content, sources of software and hardware, and comments on some of the PET-related products available.

E. T. Greeley
Rome NY

Every Key

I was looking through my Radio Shack Level II's memory map the other day and poking and peeking around, when I ran across some interesting information that might be of interest to your readers.

Every key on the keyboard is available for direct access by the user. That means *every* key, including the four arrows and clear key. By typing in the program below, some programmers can get some ideas on how to put this to use. Probably the first and foremost use would be in games, where instead of using INKEY$ and U or D for up and down the programmer might directly use the arrows. The interactive clear key could be used the same way Level I uses it by clearing the screen while the program is executing if there is a need to do so.

```
10 CLS
20 IF PEEK(14400) = 8 THEN PRINT
   "UP";
30 IF PEEK(14400) = 16 THEN PRINT
   "DOWN";
40 IF PEEK(14400) = 32 THEN PRINT
   "LEFT";
50 IF PEEK(14400) = 64 THEN PRINT
   "RIGHT";
60 GOTO 10
```

After running this program, start depressing the four arrow keys, and see how smoothly the operation runs.

Greg Perry
Tulsa OK

Simplifying "Depreciation"

Joe Ligori's program for the comparison of methods of depreciation, which appeared in the April issue (p. 82), may be simplified somewhat at lines 200-206 by substituting the following line for all of those mentioned above:

```
200 T = (Y*(Y + 1))/2
```

For example, given a useful life of ten years, this is the desired answer:

```
55 = (10*(11))/2
```

Michael C. Harris
Elkins WV

Curious Catasquian

In his attempt to compare algorithms ("Testing PET Search Algorithms," April 1979, p. 112), Mr. Morse discovered that a FOR loop is faster than a routine containing a GOTO, and that a GOTO that goes to its own line number is faster than one that goes somewhere else . . . and someone has labeled all this as "curious idiosyncrasies."

Isn't it obvious that a routine that does not require a line-number search is faster than one that does? Also, PET (Microsoft) BASIC has a somewhat optimized GOTO. A few tests are made before a line-number search is begun. I have seen BASICs that ran at half the speed of PET BASIC. Those are the ones I would call "curious."

Earl Wuchter
Catasqua PA

Polishing "Diamonds"

I enjoyed the "Two Diamonds" game by Bill Colsher in the April

```
0473 IF ABS(X1-X)=1 IF ABS(Y1-Y)<>1 F=1:RET.
0474 IF ABS(X1-X)=2 IF ABS(Y1-Y)<>2 F=1:RET.
0475 IF ABS(X1-X)=0 IF ABS(Y1-Y)>4 F=1:RET.
0476 IF AB(X1-X)>2 F=1:RET.

0703 IF B(3,5)<>0 T.750
```

Additions to "Two Diamonds" program.

1979 issue (p. 115); however, I would like to make the following correction and suggestions. Line 90 has a typographical error in running J from 0 to 5—it should run from 0 to 9. Second, the program only checks for attempts to use "unusable" spaces. I have reworked the program, adding lines 473, 474, 475 and 476, which check for moves from permissible locations and only permit those in accordance with the rules. Line 703 adds the restriction that the 0 must be returned to the center of the board before the game is over.

I enjoy your magazine. Please try to keep up the number of 6800 articles. The renumbering editor in the January 1979 issue was absolutely outstanding!

C. H. Looney
Hyattsville MD

Mr. Looney is right. Sorry about the typo in line 90 (though they let me know people like my programs!).

Bill Colsher
Lisle IL

Long Live Lexicography!

I, too, was thrown by Ancelme's reference to ASCII being people who cast no shadow (see "Letters," March 1979, p. 22). Having no *Webster's Unabridged*, I turned to my 1911 copy of Laird & Lee's *Webster's New Standard Dictionary* and found this: ASCIANS (as'si-anz), n. pl. Inhabitants of the torrid zone who at midday of one or two days in the year cast no shadow, the sun being directly overhead. (L. *ascii*; from Gr. *askioi*, pl. of *askios*, without shadow; from *a* priv. and *skia*, shadow.)

Leaving all that aside, have you tried to pronounce USASCII?

Dr. X
The Chroma-Zone
San Francisco CA

Ascii have been discovered only betwixt the Tropics of Cancer and Capricorn, never in the higher latitudes. Apart from this, detection is not facile owing to the paucity of their penumbral solar eclipse. Please also bear in mind, if intending to mount a hunting expedition, that there will more than likely be Englishmen and mad dogs in their immediate vicinity.

M. Parris
Victoria BC
Canada

Mr. Roichel must have been exposed to the classics or a classicist. The prefix A- means devoid of. SCI- is defined by *Webster's* as being a prefix referring to shadows. Finally, the terminal I is constructed to be the masculine plural suffix. Put them all together; they spell ASCII—men without shadows. I hesitate to spoil Ancelme's fun by suggesting that the proper form might be ai askioi. I suppose next he will be complaining you should say omnibus instead of bus.

David Block
Gainesville FL

Ancelme Roichel's "transcendentally cryptic statement" needs no translation, but could bear a close look at pronunciation. My *Webster's* lists ascian as "a person who casts no shadow at noon; said of the inhabitants of the torrid zone where the sun is vertical for a few days each year." Unfortunately, the word is pronouned "ash yan."

Serendipitously, the word asci also appears! This is shown as the plural of ascus. An ascus, it turns out, is a "spore sac in an ascomycetous fungus." I think this word fits the mold a lot better.

Warren S. Kirkland
Security CO

Also contributing to this etymological elucidation were Warrick M. Locke of Milpitas CA and Gary Harris of Panorama City CA. Thanks, one and all.—Editors.

EPROM Follow-up

Two of your readers wrote me to tell me that my "El Cheapo EPROM Programmer" (*Kilobaud MICROCOMPUTING*, March 1979, p. 46) would work on the Intel 2716 16K EPROM as well as the 2758 by one's merely rewiring pin 19 to the A10 address line. As far as I can discover, only the Intel version allows the 5 volt programming pulse to be used as required with the programmer I described.

Dr. Ward J. McFarland, Jr.
New Haven CT

Editorial Review

Thank you for publishing the excellent guest editorial, "Review That Book!" by Rod Hallen (March 1979, p. 7).

All any book publisher wants is a fair appraisal. Some reviewers are going to like the book and some aren't, but as long as the reviewer is fair, I'm happy.

Keep up the good work!

Merl K. Miller
Publisher, dilithium Press
Portland OR

PUBLISHER'S REMARKS

(from page 5)

you need, and you'll be helping others as you learn.

Once you know your way around a half dozen different microcomputer systems, both the hardware and software, you will be ready for your next big step: experience in the industry. I suggest starting with a computer store since you'll get invaluable experience there for anything you may want to do later on. You'll be able to learn about servicing, selling, purchasing, advertising, bookkeeping, printing, shipping, accounting, contracts, taxes, governmental problems, licenses, financing. If you work for a store and don't learn about all those things (and a lot more), it means that you have not been taking advantage of your job.

Getting the Job

It's awfully easy to get work if you go about it the right way. Will it surprise you that about 99.9 percent of the people looking for work go about it all wrong? We have whole industries, such as job-placement outfits and resumé-writing firms, built up around the wrong way to get a job. You don't want to waste the time and expense of preparing a resumé. What you really should do is sit down and think about selling yourself . . . and getting the best price you can for the package.

If you think about a resume for a moment, you'll recognize that it is mostly self-satisfying. Few resumés are written with the view of selling your experience and talents. The key to all selling can be boiled down to two simple words: *user benefits*. So, taking these two words in hand, how can you apply them to getting that job you want?

First, you have to be aware of the vast difference between looking for a job and looking for a career. You're looking for a career, not a job. This means that you are in no way looking for a firm that has a job opening. You will never ask if the firm needs someone or has an opening because that is irrelevant. The talents and experience you have to offer are such that the firm you choose *has to hire you*.

You can sell yourself to any firm if you keep in mind the user benefits. What are the benefits to the firm of having you work for them? If you are talking to the president, and you should be, since you'll be able to learn far more with a small firm than with a large one—be sure to make the benefits that you will bring to the president abundantly clear. You'll be able to help make more money for the firm and you can then explain exactly why. Bring out everything you can think of that will benefit the firm and your interviewer.

For several years I've been writing in my editorials that I am looking for people to join the staff. In all of that time I don't think anyone has ever tried to sell me on what he or she could do for me. I get resumés by the gross, and they tell me very little.

If someone walked into my office and said to me that he had been looking over *Kilobaud MICROCOMPUTING* and he could put together a book of programs we had already published which would sell at least 5000 copies for a gross profit of at least $15,000, I would start listening closely. If he went on to say that this would take him no more than a week or two and that then he'd like to start writing to every known programmer to get us more programs for both *MICROCOMPUTING* and Instant Software, I'd be real anxious not to let this ball of fire get away.

You can get into just about any

firm you want if you put a little work into it. First, pick out a likely business and then start checking it out for its needs. It doesn't hurt to visit the place and talk to the people working there. This can give you invaluable leads toward things that they need to have done.

Put yourself in the seat of your prospective employer and see what might be attractive to him. Would the certainty of increased income be a selling point? How much do you think I would pay for someone who could get a dozen books produced for us during a year? How much would an advertising salesman who could sell $250,000 worth of advertising a year be worth?

What have you to offer a computer-store owner? This is a great way to gain your experience, but you have to be worth at least the minimum wage to start getting this experience.

Let's say you have a good background in hardware service, so you'll be able to step right in and produce a faster turnaround on servicing for the owner. This could save a lot of money and time on equipment that otherwise might have to be returned to the factory.

You can also help keep the book section and magazines straight for him, help sell systems to customers—perhaps do some simpler custom programming for business customers—see that his inventories are kept up to snuff, do a lot of the paperwork that has gotten behind, and maybe even bring in a lot of the friends you've made through the computer club and users groups as customers.

If you can't get into the place this way, you might try a left-handed approach by providing some free-lance service for him for starters, charging per job instead of by the hour. The main thing is to get your foot in the door and then work hard, always doing much more than you're paid to do.

No matter what work you are doing, make it your business to know more about it than anyone else. If you are involved with bookkeeping, start reading books on the subject and maybe even take a night course. Read every magazine even remotely involved with your work. (I read over 150 magazines a month, plus several books and a lot of spec sheets and instruction books, to keep up with my work.)

It's good to make letter writing simple for yourself. Always have typewriter, paper, envelopes, stamps at hand so you can quickly dash off a letter asking for information, order parts, confirm telephone orders.

Point out how you can benefit the owner of a business, and you will usually have a place to work. From then on it is up to you to spend every possible minute getting things done and learning more. I'll write more in the future about how to parlay this into a fortune.

I practice what I preach, and I have the results to prove it. Everything I mentioned in the first paragraph I pulled from my own experience. Twenty years ago I had a yacht, two Porsches, my own plane, an Arabian horse and had already been around the world once. I'm having so much fun now with my magazines and Instant Software that I don't have time to horse around. I still travel around the world a bit, despite the horrendous cost of travel these days.

Now that I know exactly how to start a new magazine, it isn't very difficult—and a new magazine adds another million dollars or so to the yearly gross. Once you understand the fundamentals of success and how to work toward it, there is almost no way you can fail. Anyone who really wants to can become a millionaire within five to seven years—and in the microcomputing field I'd shorten that to a maximum of five years, just starting from scratch.

About 15 years ago, I started thinking seriously about the basic difference between people who were making it and those who were aiming at mediocrity and poverty for life. Once I began thinking about it and doing a bit of research, I found that there were some secrets that hardly anyone had recognized.

Unfortunately, these secrets are very difficult for those inculcated by the establishment to accept, no matter how obvious they are. Having facts and reason on my side helps some in arguments, but not a lot. Many people wasted a lot of their lives because they didn't take the time to sit down and figure out the ramifications of what they were doing. If you're really interested I'll continue this exposé into the secrets of success. Let me know.

BOOKS

(from page 14)

The Datasearch Guide to Low Capital, Startup Computer Businesses
Datasearch Incorporated
Memphis TN, 1977
156 pages, Softbound, $20

When I saw the ad for this book in *Kilobaud MICROCOMPUTING*, I thought that this was just what I was looking for. I wanted a home computer that would pay for itself, and this book would apparently provide the answers I needed. This turned out not to be the case.

This book is not aimed at the computer hobbyist, but rather at the computer professional who is looking for extra income.

There are, in fact, 22 ideas for businesses, as advertised, but they deal mainly with the sales area. Unless you have a knowledge of the major computer industry, and this does not include micros, the ideas will not be of much use to you.

Micros are covered briefly in two small sections. One section deals with home computers coming of age, and the other section covers program and peripheral development needed for this industry, but does not give any real information or ideas on how to tap this area. It does mention Instant Software, but any regular reader of *Kilobaud MICROCOMPUTING* will get more information on this from the editorials than is provided in this guide.

The copyright statement states that no specific guidance for a business is intended, and I was not looking for specifics, anyway, but ideas. This book has them, but not in the areas I expected.

There are sections dealing with image building and personal evaluation. These are a must if you plan to start your own business, and I think they are well covered.

Is this book worthwhile? If you are a computer professional and thinking of venturing off on your own—yes. In addition to giving you some ideas, it will help you to evaluate yourself and your prospects for success. It also offers some good image-building advice. If you are a hobbyist looking for a way to make your system pay for itself, the ideas in this book will not be very helpful to you.

Thomas Laich
Charleston SC

PET-POURRI

(from page 12)

```
550 SYS(832) : REM STOP
    DISABLED
```

You should disable the STOP key while you are playing music or producing sound effects via user-port pins M and N. If a user stops your program while in the sound mode, his/her tape units will not function correctly. You can enable the STOP key again with this line:

```
650 SYS(845) : REM ENABLE
    STOP
```

Be careful about adding this to your program while you're still testing it. You won't be able to stop your program unless you include a way out. This could be a simple GET command that monitors your keyboard. For example:

```
1200 part of program is here
1210 GET A$ : IF A$="Q"
     THEN END
1220 program continues here
```

Next month I will tell you about Axiom's graphic plotter for the PET with some sample output. Also, I'll relate more general, helpful tips and sources for materials.

Please write with your comments and suggestions to Len Lindsay, 1929 Northport Drive, Room 6, Madison WI 53704.

Contest!

March's "best article" winner is Gregory Yob, author of "PET User Port Cookbook."

In the Book Nook drawing, Rudolf Lehn of Ertingen West Germany is the recipient of a book choice.

Winner of a lifetime subscription to *Microcomputing* is listed on page 4.

Congratulations, everyone.

"Monitor"

"Monitor" is a Level II TRS-80 assembly-language operating system with many capabilities.

Rod Hallen
Road Runner Ranch
PO Box 73
Tombstone AZ 85638

Although I have owned a SOL for almost two years, I recently purchased a 16K Level II TRS-80 from Radio Shack. I write and sell magazine articles and programs, and since the TRS-80 is fast becoming one of the more popular of the personal computers, I decided that I had to have one to keep abreast of the latest trends in the industry.

One distinct advantage of the TRS-80 and other personal computers of a similar nature is that the BASIC interpreter is stored in ROM. Every time you turn the machine on you have immediate access to BASIC. This is in contrast to computers, such as my SOL, that contain assembly-language operating systems in ROM. This gives you direct control of the inner workings of the CPU but requires loading BASIC from

Program A. A listing of "Monitor—A TRS-80 Assembly-Language Operating System," written in Radio Shack's Level II BASIC. It occupies about 2K of RAM. Delete the REMarks and line 310 to run in a 4K system.

```
100 REM-TRS-80 ALOS
110 REM-BY ROD HALLEN  TOMBSTONE, AZ 85638  20 NOV 78
120 REM-TAPE 15 SIDE 2 --> 105
130 DIMA$(16),S(16):A$="0123456789ABCDEF"
140 CLS:PRINT
150 PRINTTAB(25)"MONITOR":PRINT
160 INPUT"SELECT: DUMP, ENTER, EXECUTE, SAVE, LOAD, OR BASIC. ";C$
180 IF LEFT$(C$,2)="DU" THEN 310
190 IF LEFT$(C$,2)="EN" THEN 610
200 IF LEFT$(C$,2)="EX" THEN 910
210 IF LEFT$(C$,2)="SA" THEN 1110
220 IF LEFT$(C$,2)="LO" THEN 1310
230 IF LEFT$(C$,2)="BA" THEN END
240 GOTO 160
300 REM-DUMP SUBROUTINE
310 PRINT:PRINT"ENTER START AND END ADDRESSES IN HEX."
320 PRINT:INPUT"START ADDRESS ";H$(1)
330 PRINT:INPUT"END ADDRESS ";H$(2)
340 FOR I= 1 TO 2
350 H$=H$(I)
360 GOSUB 1510
370 D(I)=D
380 NEXT I
390 FOR I = D(1) TO D(2) STEP 16
393 D=I
396 GOSUB 1710
400 PRINT MID$(A$,H4+1,1);MID$(A$,H3+1,1),
405 PRINT MID$(A$,H2+1,1);MID$(A$,H1+1,1); "   ";
410 FOR J = 0 TO 15
420 D = PEEK(I+J)
430 GOSUB 1710
440 PRINT MID$(A$,H2+1,1);MID$(A$,H1+1,1);" ";
450 NEXT J
460 PRINT
470 NEXT I
480 GOTO 160
600 REM-ENTER SUBROUTINE
610 PRINT:INPUT"START ADDRESS OF ENTER IN HEX ";H$
620 GOSUB 1510
630 D1 = D
640 FOR I = 0 TO 8191
650 INPUT H$
660 IF H$="/" THEN 160
670 GOSUB 1510
680 POKE D1+I,D
690 NEXT I
700 GOTO 160
900 REM-EXECUTE SUBROUTINE
910 PRINT:INPUT"EXECUTE ADDRESS IN HEX ";H1$
920 FOR I = 2TO4 STEP 2
930 H$=MID$(H1$,I-1,2)
940 GOSUB 1510
950 POKE 16528-I/2,D
960 NEXT I
970 PRINT USR(0)
980 GOTO 160
1100 REM-SAVE SUBROUTINE
1110 PRINT:INPUT"ADDRESS OF SAVE START IN HEX ",H$
1120 GOSUB 1510
1130 D1=D
1140 PRINT-INPUT"ADDRESS OF SAVE END IN HEX ";H$
1150 GOSUB 1510
1160 D2=D
1170 FOR I = D1 TO D2 STEP 16
1180 FOR J = 0 TO 15
1190 S(J+1) = PEEK(I+J)
1200 NEXT J
1210 PRINT#-1,S(1),S(2),S(3),S(4),S(5),S(6),S(7),S(8),S(9),
S(10),S(11),S(12),S(13),S(14),S(15),S(16)
1220 NEXT I
1230 PRINT#-1,999,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
1240 GOTO 160
1300 REM-LOAD SUBROUTINE
1310 PRINT:INPUT"ADDRESS OF LOAD START IN HEX ";H$
1320 GOSUB 1510
1330 FOR I = D TO 32767 STEP 16
1340 INPUT#-1,S(1),S(2),S(3),S(4),S(5),S(6),S(7),S(8),S(9),
S(10),S(11),S(12),S(13),S(14),S(15),S(16)
1345 IF S(1)=999 THEN 160
1350 FOR J = 0 TO 15
1360 POKE I+J,S(J+1)
1370 NEXT J
1380 NEXTI
1390 GOTO 160
1500 REM-HEX TO DECIMAL SUBROUTINE
1510 D=0 : RESTORE
1520 Z=LEN(H$)
1530 FOR K = Z TO 1 STEP -1
1540 READ M
1550 FOR J = 1 TO 16
1560 IF MID$(H$,K,1) = MID$(A$,J,1) THEN X = J-1: J=16
1570 NEXT J
1580 D = D+X*M
1590 NEXT K
1600 RETURN
1700 REM-DECIMAL TO HEX SUBROUTINE
1710 H4 = INT(D/4096)
1720 H3 = INT((D-H4*4096)/256)
1730 H2 = INT((D-((H4*4096)+(H3*256)))/16)
1740 H1 = D-((H4*4096)+(H3*256)+(H2*16))
1750 RETURN
1800 REM-2 DIGIT DEC TO HEX SUBROUTINE
1810 H2=INT(D/16)
1820 H1=D-H2*16
1830 RETURN
2000 DATA 1,16,256,4096
```

```
ADDRESS  MACHINE     LABEL   MNEMONICS           COMMENTS
         CODE
7000     21 00 3C            LXI   H,3C00H      SCREEN ADDRESS
7003     1E 04               MVI   E,04         REPEAT 4 TIMES
7005     AF          REPEAT  XRA   A            CLEAR A REGISTER
7006     77          LOOP    MOV   M,A          MOVE TO SCREEN
7007     23                  INX   H            INCREMENT SCREEN
7008     3C                  INR   A            INCREMENT CHARACTER
7009     FE FF               CPI   255          COUNT CHARACTERS
700B     C2 06 70            JNZ   LOOP         GO BACK FOR MORE
700E     1D                  DCR   E            COUNT REPEATS
700F     C2 05 70            JNZ   REPEAT       GO AROUND AGAIN
7012     C9                  RET                RETURN TO CALLER
```

Program B. A simple 8080 assembly-language program designed to display the contents of the TRS-80 character set. When entering it into memory, only the machine code is actually entered. Change 70 at 000D and 0011 to 4C for the 4K version.

cassette.

However, if you like to work with assembly-language programming as much as I do, then the advantage and the disadvantage trade places. I had almost made up my mind to buy Radio Shack's T-BUG assembly-language monitor when the idea occurred to me that I ought to write my own version. My first intention was to write it in Z-80 machine code, but at the time I was looking for a project that would enable me to get to know Level II BASIC better, so I decided on a BASIC ALOS (assembly-language operating system).

By writing ALOS in BASIC I also increased its portability, which is the ability to move programs from one machine to another. While you can easily rewrite this program to fit almost any computer that supports BASIC, it is designed for the Level II Radio Shack machine. It occupies about 2K bytes of RAM, and with a little squeezing (see Program A) it will fit and run inside of 4K, but it really shines if you have more memory than that.

I patterned my TRS-80 version after Processor Technology's SOLOS monitor, with which I am quite familiar. That is, some of the functions are the same, but otherwise there is no similarity since SOLOS is written in assembly language and ALOS is written in BASIC.

Here are the ALOS commands that I felt were necessary:

DUMP: select and print any desired block of memory.
ENTER: put machine code into selected memory.
EXECUTE: run an assembly-language program that has been loaded from the keyboard or cassette tape.
SAVE: save on tape an assembly-language program that now resides in memory.
LOAD: load a program from tape into memory.

With these commands I have complete control of the TRS-80 and can now enter and run 8080 or Z-80 assembly-language programs. A command that combines LOAD and EXECUTE might also be desirable, but I found that I don't really need it because it would enlarge an already memory-hungry program, which is especially undesirable if you only have 4K to work with.

Implementation

Let's consider how to use ALOS before we go into a step-by-step explanation of how it works. I'll use Program B as an example of an assembly-language program that we've written and now want to try out

This simple program will fill the video screen with the entire TRS-80 character set four times. Unfortunately, the lowercase characters will be shown as uppercase, but I have recently come across both software and hardware methods of remedying this problem, which I consider Radio Shack's one major oversight as far as the TRS-80 is concerned.

We will enter the program from the keyboard, dump it to the screen to be sure we didn't mistype anything, execute it to verify that it does what we want it to do, save it on cassette tape for future use and load it from tape to make sure that we got a good save.

As you can see the machine code of Program B is written in hexadecimal notation. I use hex because that is what the SOL taught me and because most of the assembly-language programs that you encounter in the magazines are in hex. However, since BASIC handles its numerical values in decimal notation, you will note when we get to a discussion of the inner workings of Program A that it is necessary for the software to constantly convert between the hex and decimal forms.

Turn off your TRS-80 and then turn it on again. This will display MEMORY SIZE? Answer 28672 if you have a 16K machine, and 19456 for the 4K version. The former will reserve 4K for machine code and the latter 1K. For longer assembly-language programs on the 16K TRS-80, you can reserve 12K by answering 20480.

When you use the memory-reservation feature of the TRS-80, remember that you are affecting the MEM command. If you type ?MEM, you will still get the number of unused bytes available to the BASIC interpreter. This will not include the memory that you reserved for machine code. However, if you normally type ?15572-MEM to find the length of a program, you will have to change it to ?15572-4096-MEM, with 4096 being the number of bytes reserved.

Enter Program A from your keyboard just as you would any other BASIC program and CSAVE a copy on tape. Type RUN and you will be presented with the Command Table. Type ENTER (or EN) and you will be asked for a start address: 7000 on the 16K machine and 4C00 on the 4K. 7000 hex equals 28672 decimal and 4C00 equals 19456, which is the beginning of our reserved memory.

After the ALOS has digested that information, it will print a question mark (?). Enter the first byte of Program B and hit the enter key; when the ? appears again, type the second byte and enter. Continue until the entire program has been typed and entered one byte at a time. After the last byte has been typed and entered, type / and hit enter to return to the Command Table.

Now we want to see if everything went into memory OK. Type DUMP (or DU) and give a start address of 7000 and an end address of 7012 (4C00 and 4C12 on the 4K machine). You should receive a printout similar to Fig. 1. We are not concerned with the data after the C9 in the second line since the program ends there.

The completion of each com-

```
SELECT: DUMP, ENTER, EXECUTE, SAVE, LOAD, OR BASIC. ? DU
ENTER START AND END ADDRESSES OF DUMP IN HEX.
START ADDRESS ? 7000
END ADDRESS ? 7012
7000   21 00 3C 1E 04 AF 77 23 3C FE FF C2 06 70 1D C2
7010   05 70 C9 FF FF FF FF FF FF FF FF FF FF FF FF FF
```

Fig. 1. The result of a DUMP command. Here we've asked for a DUMP of 7000 to 7012 hex. The data after 7012 is not part of Program B and is read from memory to fill out the line to 16 bytes.

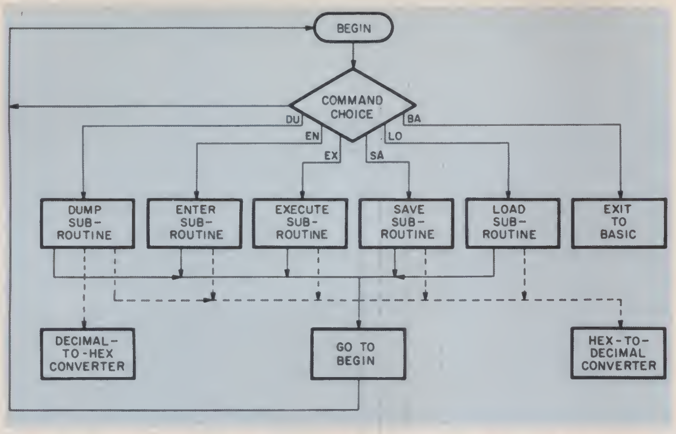


Fig. 2. The flowchart for Program A. It follows the flow of Program A and should be self-explanatory.

mand always takes you back to the Command Table for a new choice. If you detect a typing error, use the ENTER command to reenter the correct data. It is not necessary to type the entire program again in order to correct one byte. Give the address of the incorrect byte and then the correct information.

When the program looks correct, type EXECUTE (or EX) and give 7000 as the EXECUTE address (4C00 in 4K). After a moment's hesitation, the screen should fill with alphanumeric and graphic characters. The Command Table inquiry will also be printed somewhere on the screen.

Our next step is to save a tape copy of Program B. Position the tape to a blank spot and press the recorder's PLAY and RECORD buttons. Type SAVE, give a start address of 7000 and an end address of 7012 (4C00 and 4C12 for 4K). The recorder should run for a short while and then turn off.

Release the RECORD button and return the tape to the program's starting point. You do keep a written log of your taped programs, don't you? Press the PLAY button and type LOAD. Give a start address of 7000 (4C00 for 4K); the recorder should run three short spurts, and then the Command Table should return.

Try the EXECUTE command again to be sure that you got a good save and load. If anything fails to work properly, Level II BASIC should give you some clues as to the problem area. If not, compare your listing of Program A in memory with the listing in this article.

The supreme test is to turn your TRS-80 off and then on again. CLOAD Program A, load Program B from tape using the Command Table and execute. Remember that you will have to enter your reserved memory address (28672 or 19456) each time you turn the machine on.

I've performed some simple modifications to my Radio Shack CTR-41 tape recorder that make loading and saving programs much easier. These modifications allow you to hear the data on the tape and give you complete control of the recorder without constantly plugging and unplugging the cords. The total cost is one quarter-Watt resistor and fifteen minutes' work. The resistor feeds some audio to the speaker on playback, and the tone-control switch becomes a motor-control switch.

A detailed description of these modifications and a lot of other good information are in the initial issue of "TRS-80 Computing," available from Computer Information Exchange, Inc., PO Box 158, San Luis Rey CA 92068, for $1.50. I believe that the same modification information is available from Radio Shack Computer Corp., Hugh Mathias, Customer Service, PO Box 185, Ft. Worth TX 76101. I have seen gadgets (costing up to $40) to accomplish the same functions.

The Program

Program A is a listing of my BASIC ALOS. I don't have a printer interfaced to the TRS-80 yet, so I had to transfer the program to the SOL and then print it. This is a difficult and error-prone method of doing things, and it strengthened my resolve to hook up some type of printer interface for the TRS-80 so that I could use the Malibu 160 line printer that the SOL drives.

As I've said, the program occupies about 2K, which leaves 1K for machine-language programs if you have 4K and 12K in the 16K machine. In order to reduce the size of Program A for the 4K TRS-80, you can:

Remove all REMark statements.

Remove line 310, and in line 180 change 310 to 320.

Use multi-statement lines.

When I write a program for publication I use remarks and place each statement on a separate line because it is easier to read that way. However, for my own use, I prefer programs that are as compact as possible. This not only conserves memory space, but it makes for a faster-running program. Speed is an important consideration here because a BASIC program runs much slower than one written in assembly language.

Fig. 2 is the flowchart for Program A. The program and the flowchart should follow each other exactly. Fig. 3 is a list of the variables used in Program A.

Lines 100 to 120 are intended for my information, but they can be eliminated if you like. Line 130 dimensions a couple of variables and establishes the hexadecimal character set. After clearing the screen and printing a title, lines 140 to 160 ask for the command that you want to use, and lines 180 to 230 call the subroutine associated with each command. Line 240 gives you another chance if you enter something that the computer doesn't understand. Note that either the entire command or just the first two letters can be entered and that the choice of BASIC as a command provides an exit function.

Number-Base Converters

Before I detail the command subroutines, let's look at the two number-base converters, since they play such an important part in the operation of the ALOS. In Program A and the following discussion, any variable that starts with H (H$, H1$, etc.) contains a hexadecimal value, and those that start with a D (D, D1, etc.) contain decimal values.

The hex-to-decimal subroutine starting at line 1510 is always entered with a hex value in H$ and returns with the decimal equivalent in the variable D. Line 1510 clears D and restores the data pointer, and line 1520 determines how many digits are contained in H$. The loop between lines 1530 and 1590 assigns a weight to each hex digit position, and line 1580 multiplies each digit times its weight. The result, which is stored in D, is the decimal equivalent of the hex value.

The decimal-to-hex converter starts at line 1710. Each of the four hex digits is determined by dividing the decimal number by the hex-digit weights. These weights are shown in Fig. 4. The result is stored in H4, H3, H2 and H1. These are actually deci-

```
A$ = Hexadecimal character set

C$ = Command choice

H$,H1$,H$(1),H$(2) = Hexadecimal inputs

D,D1,D2,D(1),D(2) = Decimal inputs and results

H1,H2,H3,H4 = Hexadecimal digits

I,J,K, = Loop variables

M = Hexadecimal digit weight storage

S = Storage of tape input and print files

Z = H$ length
```

Fig. 3. A list of the variables of Program A and an explanation of their use.

mal digits ranging from 0 to 15, and these digits (+1) are compared in lines 400, 405, 440 to their position in A$ to recover the hex equivalent.

DUMP

If you want to look at a specific block of memory, you would enter DUMP (or DU) in response to the question in line 160, and line 180 would jump to line 310, which is the beginning of the DUMP subroutine. Line 310 reminds you that all entries are in hex (as are all printouts). Line 320 is looking for the start address of the DUMP, and 330 is looking for the end address. If you answered 0 and 3F, the result should be similar to that shown in Fig. 5. This is the first 64 bytes of the Level II BASIC interpreter.

Fig. 5 came about as follows: Lines 320 and 330 stored the starting and ending addresses in two variables, H$(1) and H$(2). The loop in lines 340 to 380 calls the hex-to-decimal converter starting at line 1500 and creates two new variables, D(1) and D(2). These are identical to H$(1) and H$(2), except that they contain the decimal equivalent of the DUMP start and end addresses.

The loop between lines 390 and 470 calls the decimal-to-hex converter (at line 396), prints the memory address (lines 400 and 405) and prints 16 bytes of data (lines 410 to 450). Line 460 starts a new line, and line 470 sends us back for the next address and another 16 bytes. This continues until you encounter the end address that you originally entered. The program completes the line that it is working in and then goes back to line 160 for a new command.

ENTER

The ENTER subroutine asks for the address at which you want to start entering data (line 610) and sends that address to the hex-to-decimal converter (line 620). On return we have a decimal variable (D) containing the start address. We're going to need D for another conversion in a moment, so we move its contents to D1 (line 630).

The loop from lines 640 to 690 will allow up to 8K (8192 bytes) to be entered. This can be easily changed in line 640 to suit your requirements. Line 650 asks for a byte, line 660 checks to see if it is /, which we use to exit the ENTER command, line 670 converts it to decimal, line 680 pokes it into memory and line 690 goes back for another byte. This continues until line 660 or a fallout to line 700 returns us to the Command Table.

EXECUTE

In order to execute an assembly-language program in the TRS-80, you must poke the execute address into memory at 16526 and 16527 and then call that address by using the Level II USR(0) command. You can approximate the same function by using the following assembly-language segment:

```
LXI     H,EXECUTE ADDRESS
PUSH    H
RET
```

When the CPU encounters the return (RET) it will take the top two bytes—your execute address—off the stack, place them in the program counter and proceed from there. This latter procedure, of course, assumes that you are already in the assembly-language mode.

Line 910 asks for the execute address, and the loop from lines 920 and 960 splits it in half (half for 16526 and half for 16527—least significant byte first). Line 930 executes the actual splitting, line 940 calls our hex-to-decimal converter and line 950 pokes 16526 and 16527. Line 970 is a call to 16526 and 16527. Your machine-language program should end with some variation of the RETURN instruction (RET, RZ, RNZ, RC, RNC, etc.), and control will be returned to line 980 when it is done.

SAVE

It is, of course, desirable to be able to store programs on cassette tape after they have been entered and tested so that you don't have to reenter them from the keyboard each time you want to run them. Level II BASIC makes this easy to do.

Line 1110 asks for the start address of the program you want to save, line 1120 calls the hex-to-decimal converter and line 1130 assigns this value to D1. Line 1140 is looking for the last address you want to SAVE, line 1150 converts it to decimal and line 1160 assigns this value to D2.

The loops between lines 1170 and 1220 do the actual SAVEing. Machine code is recorded on tape as 16 byte files. Lines 1180 to 1200 store 16 bytes in the S array, and line 1210 puts them on tape as a file. If we're not done yet, line 1220 goes back for another 16 bytes. If the program that you are SAVEing does not contain an exact multiple of 16 bytes, the last file will be filled out with whatever follows the program in memory. Line 1230 records "999" as an identifier on tape so that the LOAD routine will know when it has reached the end of a taped program.

LOAD

Line 1310 is looking for the address at which you want the program loaded, and line 1320 is our old friend, the hex-to-decimal converter. Line 1330 starts a loop that will LOAD until it runs out of memory unless something stops it. Line 1340 will load 16 bytes at a time. Lines 1350 to 1370 will poke those 16 bytes into memory, and line 1380 will keep going back for more until line 1345 discovers "999," which indicates we're done.

As I mentioned earlier, LOAD and EXECUTE could be combined by calling the EXECUTE subroutine when the load is done. It would also be quite easy to put the LOAD start address at the beginning of the program on tape. Then all you'd have to do is type LO for the program to load at the proper address and execute.

I haven't implemented either of these functions because most of the time I'm experimenting, and I often load a program and make changes before I run it. If you'd like an automatic load and execute, the follow-

Digit Position	4	3	2	1
Decimal weight	1000	100	10	1
Hex weight	4096	256	16	1

Hex Digit	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
A$ Position	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16

Fig. 4. The comparative weights of hex and decimal digit positions. The hex positions are in multiples of 16, and the decimal positions are in multiples of ten. For instance, 1234 decimal equals one thousand, two hundred thirty-four ($1*1000+2*100+3*10+4*1=1234$). 1234 hex equals four thousand, six hundred fifty decimal ($1*4096+2*256+3*16+4*1=4650$). Also shown are the contents of A$ and how the results of the decimal-to-hex converter are used to identify the correct hex digits.

```
SELECT: DUMP, ENTER, EXCUTE, SAVE, LOAD, OR BASIC. ? DU
ENTER START AND END ADDRESSES OF DUMP IN HEX.
START ADDRESS ? 0
END ADDRESS ? 3F
0000   F3 AF C3 74 06 C3 00 40 C3 00 40 E1 E9 C3 9F 06
0010   C3 03 40 C5 06 01 18 2E C3 06 40 C5 06 02 18 26
0020   C3 09 40 C5 06 04 18 1E C3 0C 40 11 15 40 18 E3
0030   C3 0F 40 11 1D 40 18 E3 C3 12 40 11 25 40 18 DB
```

Fig. 5. A DUMP of the first 64 bytes of the Level II BASIC ROM. The addresses requested were 0 to 3F hex (0 to 63 decimal).

ing suggestions should help.

Add lines 1115 H1$ = H$ and 1165 PRINT# – 1,H1$. This will make the first file on tape the SAVE start address. Change line 1310 to INPUT# – 1,H$ and delete line 1320. In line 1345 change 160 to 920. With these changes, you will still be able to use the EXECUTE command by itself when desired.

Note that the above procedure assumes that the first address of a program and the EXECUTE address are the same. I always write my assembly-language programs that way. If for some reason you want to start executing in the middle, then make the first assembly-language program instruction a jump to the start location.

Conclusion

BASIC certainly has its advantages. Foremost is its ease of constructing complicated programs. However, it does have two distinct disadvantages: the large amount of memory required to store these programs and the slowness of their operation. Add to this the memory required to hold the BASIC interpreter, and there are many times when assembly-language programs are desirable or even necessary.

Assembly-language programming is more difficult to learn and use than BASIC, but it does have the virtue of compactness and speed. I read somewhere recently that a well-written assembly-language program will run at least 100 times faster than its BASIC equivalent. For those of you who are familiar with 8080 machine code, the TRS-80 will accept and run it as well as it does Z-80 code. I haven't attempted to provide any instruction on the subject of assembly-language programming because that would consume quite a few articles all by itself.

Since speed and compactness are factors to consider in BASIC programs, you might want to go through my ALOS and clean it up a little. The statements within loops are especially profitable candidates for cleanup since they are executed so many times. The hex-to-decimal converter is another area to look at.

One interesting possibility is to use my ALOS to construct and experiment with an ALOS written in assembly language. You could then discard the BASIC version. In any case, using the information that I've provided here, you can now go into the inner regions of your TRS-80 and speak to it in its own language. ■

Reader Service—see page 179

✓ Reader Service—see page 179

TRS-80/Selectric Word Processor

This word-processing system has many genuinely useful applications. Read and see.

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As the hobby computer market continues to grow, increasingly more attention is given to questions about the actual or potential utility of the personal computer. In spite of claims that the microcomputer will revolutionize the home, skeptics are demanding answers as to how and in what ways this so-called revolution will occur. After all, playing blackjack or balancing a checkbook with a microcomputer is hardly revolutionary.

As a partial answer to the skeptics, let me suggest the usefulness and affordability of a personal word-processing system. Here, finally, is something practical and simple enough for most of the family to enjoy. And, more important, the cost is gradually becoming somewhat reasonable. My TRS-80/Selectric word-processing system cost about $2000, including the price of the TRS-80. You can do the same with off-the-shelf products and with very little technical hassle.

But first you may reasonably ask what you or your family can do with a personal word processor. At the very least, it makes any typing chore a piece of cake. For example, as a pseudotypist I can sometimes manage up to 30 words per minute, but my problem is that erasures and corrections slow me down considerably. And when my letter or term paper, or whatever, is finally finished, the "final" copy is usually unsatisfactory, and typically I wind up cutting out paragraphs, rearranging the text and retyping.

Needless to say, this traditional method is tedious and slow. But no more. Now I can erase faster than 100 words per minute. Term papers for college courses are much less tedious, and my final copy for the professor is always typed error-free on standard-size white bond paper.

In addition to high school or college term papers and theses, routine letter writing or typing becomes much simpler and faster. In fact, just about any kind of correspondence generated in the home for friends, business associates, consumer complaints, etc., is just the thing for a home word processor. Typed consumer complaints are much more effective than the typical handwritten variety.

Consider, too, the preparation of job resumés. When the young college graduate, or the recently laid-off breadwinner for that matter, goes job-hunting, he should tailor each resumé for each different employer. For example, he may choose to emphasize his computer background to IBM or his stock market winnings and skills to Merrill Lynch.

Additionally, an original typed copy is much more impressive to the potential employer than a standardized machine copy. You can be certain that a "personally typed" resume will stand out in a pile of machine copies.

As one more example of what my word processor can do, I would like to pay tribute to my daughter Kelli and her ingenuity. She wanted to know if the system would automatically type out 100 times: "I will not chew gum in school." The answer is, "Of course." Simply type out the sentence once on the monitor and give it a print command for, say, 50 times per page. The TRS-80 word processor makes duck soup out of these previously time-consuming chores.

The Basic System and Cost

When bragging about the super capabilities of my TRS-80 word processor to other computer owners, I am frequently asked: "What can your word processor do that the built-in TRS-80 editor can't do?" The answer is, a lot. Let me defend this claim by starting with a description of the system components and approximate costs.

The printer I use with my Level II TRS-80 is an Anderson-Jacobson 841 IBM selectric terminal with built-in ASCII logic circuitry, and the software is Michael Shrayer's versatile Electric Pencil, a machine-language word-processing program. My TRS-80 system has 48K, but 16K is adequate, thus keeping down the initial cost of the basic system. The Pencil will also run on a Level I system.

The Level II, 16K TRS-80 currently retails for $988; the AJ-841 is currently advertised at $1095 (in a different computer mag); and the Electric Pencil is advertised at $99.95 (see *Kilobaud*, December 1978, p. 35).

For some additional money-saving possibilities, Tandy shareholders qualify for a ten percent discount on Radio Shack products, including the TRS-80, and at least one retail outlet is advertising ten percent or more off on Radio Shack computer products (see the V. R. Data Corp. ad in *Kilobaud*, December 1978, p. 110).

This hardware-software combination compares favorably with commercial word processors retailing for many more kilobucks. With some arithmetic computations on your pocket calculator (assuming you don't yet have a microcomputer), you can add up the prices I gave you (minus the possible ten percent or more savings on a Radio Shack TRS-80) and arrive at a total system cost of around $2000, less sales tax. Of course, if you already have a TRS-80, you are halfway there.

The Electric Pencil

The Electric Pencil has far more flexibility and capability than can be described in the limited space of this article. (See *Kilobaud MICROCOMPUTING*, March, 1979, p. 114.) The Electric Pencil operator's manual contains 24 pages of clear, well-written instructions.

In addition to mere insertion, deletion or addition of charac-

ters or words, the Pencil supports block moves as well. Paragraphs, sentences or any group of characters can be relocated from one area in the text to another. The block move operation automatically adjusts to close up the text previously occupied by the block, and the newly assigned area is automatically opened up to provide space for the relocated text.

Forward and reverse scrolling (moving the text up or down on the monitor screen) permit easy viewing of all parts of the text, both before and after block move(s). String search also facilitates text review and analysis.

String search allows the user to locate any desired string of characters with reference to a name, social security number, age, address or whatever. Not only does this search capability facilitate block moves, but also mailing or address lists can be constructed without a need to alphabetize. Simply tell the computer to display the file on John Doe, and there it is.

Typing speed is enhanced by the automatic carriage-return feature at the end of each line of text and by eliminating the requirement for hyphenation. Simply keep right on typing, and any text word that does not completely fit at the end of the current line is automatically reconstructed as a whole text word at the start of the next line. Of course, a carriage return can be inserted anywhere by the user for shorter lines or for column construction.

Other features of the Electric Pencil include automatic pagination and titling, right-hand justification, an assortment of print commands and so on. If you choose to have the printer type out 80 characters per line (or up to 125 characters per line), as opposed to the 65 characters per line displayed on your monitor, simply select the appropriate command for the number of characters per line desired and give the print command. All line and word spacing is adjusted automatically.

If your computer memory becomes filled with text, "FILE AREA FULL" will be displayed on the monitor. You can then dump the text from memory onto cassette tape. A "Tape Verify" feature assures a good tape load. Of course, a tape dump can be performed at any time.

The Electric Pencil has many more versatile features—I counted 52 different controls and commands—but the preceding paragraphs should give the reader a good idea of the program's capabilities.

Photo 1. TRS-80 and printer.

The AJ-841 I/O Terminal

The TRS-80, the Electric Pencil and the AJ-841 terminal form a natural trio, almost as if they were designed to function together. The TRS-80, however, is deficient because of its uppercase-only capability, whereas the IBM-based AJ-841 supports both uppercase and lowercase.

Not to worry . . . the Pencil documentation provides complete instructions to easily convert your TRS-80 into an uppercase and lowercase system. Total cost of the lowercase mod is less than $5 for parts. Installation of the mod was my first experience in hard-wiring a microcomputer, and it was quite simple—it took less than an hour.

Be aware that this lowercase conversion will void your TRS-80 warranty, so you may want to allow the computer to age for the 90-day life of its warranty before installing the mod. In this way, any bugs that happen to develop in a new TRS-80 can be repaired under the warranty at no cost to the owner.

After expiration of the 90-day warranty, however, you will have to pay for repairs anyway, so go ahead and modify it . . . it's easy. (One more caution: Radio Shack repairs on modified computers are billed at a higher hourly rate than on unmodified computers.)

The lowercase mod requires the installation of a 2102A memory chip ($2.49 at Radio Shack) plus two simple switches. One switch is an SPDT, which allows for upper only or upper-lower selection; the second is a push-button normally open switch that accesses the Electric Pencil's control functions such as cursor movement, printer activate and so on.

The Electric Pencil will support a stock uppercase-only TRS-80, and with this unmodified setup no wiring of any kind to the computer is required. Thus, the integrity of your TRS-80 and its warranty are preserved. This is explained very clearly in the Pencil operator's manual. Whether or not you modify, you can still utilize the Radio Shack or Centronics line printer in lieu of the AJ-841 terminal.

Back to printout capability: the Pencil allows selectable printout options of any or all parts of the text. One line or several lines can be identified for printout, and the AJ-841 supports the Pencil printout commands beautifully.

The AJ-841 terminal connects to the 34-pin printer port of the TRS-80 expansion interface. Alternatively, an RS-232 option is available from Small Systems Software, a firm that retails the Electric Pencil, if you don't use the Radio Shack expansion interface. If you go this route, you will need another RS-232 interface on the AJ-841, which is also available.

No wiring modifications to either the TRS-80 or the AJ-841 are required, but the connector cable that interfaces the two systems must be wired as described in Fig. 1. The only exception to this claim for nonwiring involves the AJ-841's logic board, which utilizes a Z-80 MPU plus a Z-80 PIO for proper handshaking with a variety of computer systems. On the logic board are two jumpers marked "P R" and "S T." See Photo 2 for jumper locations.

Instructions for setting up these jumpers are provided in

the AJ-841 documentation, and the TRS-80 requires them to be set at P and T. The jumpers do not have to be unsoldered and resoldered to be moved. They are friction-fitted on mounting posts that are mounted on the logic board.

Carefully pull the jumpers off the mounting posts with long-nose pliers and reposition them as required. (On my AJ-841, the jumpers were already properly positioned, so they did not have to be moved.) Proper positioning of the jumpers provides high and low logic handshaking signals that are compatible with the TRS-80.

The TRS-80 end of the cable can easily be constructed or purchased already wired with a 34-pin, .01 inch center edge connector. My cable is four feet long. The AJ-841 end of the cable uses a standard DB 25-pin female connector.

I used a 25-pin connector with solder-type leads because the connections do not form a one-to-one correspondence between it and the TRS-80 edge connector. Solder the leads according to the instructions in Fig. 1, being careful to make neat solder connections. Also be careful of solder splashes or tiny stranded wire shorts across the 25-pin connector terminals.

The AJ-841 has a self-test function that automatically runs itself through a printer output of all uppercase and lowercase characters. A power supply and all necessary electronics are inside the AJ-841, and no software overhead is required. This system is therefore much simpler than the one put together by Emerson Brooks (see *Kilobaud*, June and July 1978). Once the cable is assembled, simply plug the AJ-841 and TRS-80 together and go.

It is important to note that the AJ-841 accepts all of the BASIC line printer commands from the TRS-80, such as LLIST or LPRINT. It does not, therefore, limit the user to only Electric Pencil usage. The AJ-841 supports all the functions of the standard TRS-80 line printer except for the speed. The AJ-841 advertises a printout of 14.9 characters per second, which is, of course, slower than the line printer output of about 90-100 lines per minute.

The folks at Microtronix have developed a graphics ball for the AJ-841, so you can also have the option of a graphics printout capability (see their ad in *Kilobaud*, November 1978, p. 80). And, of course, you can use any of the available IBM character print balls for different type fonts.

I might add that Microtronix retails the AJ-841 complete with cable, ready for TRS-80 operation. Their advertised price should save you the expense of purchasing the connector cable separately, but don't forget to figure in shipping costs when applicable.

Alternative Printers

Before closing, I might add why I went the AJ-841 route instead of some other IBM Selectric printer alternative. First, converting a standard IBM Selectric would probably have been a headache, and in the end it probably would not have saved much money. If a used Selectric could be found, I would have had to pay about $500 or $600, minimum. Add to this the solenoid kits available from various sources for about $250 and up; plus the ASCII, solenoid driver and power supply electronics; plus the software overhead required to make such a home-brew system work (either in PROM or resident software).

The end result would have been a printer that was not as simple, compatible or capable as the heavy-duty mechanism of the AJ-841. And the total cost of a home-converted IBM can easily approach the retail cost of the AJ-841.

As for buying inexpensive solenoids to save money as suggested by Don Lancaster (see his *TV Typewriter Cookbook*), I suggest, first, looking at the guts of an IBM Selectric. Also, consider the bewildering variety of available solenoids, plus the problem of how to mount and interface them. I wouldn't touch the project with a ten-foot pole.

If you need additional discouragement in putting together a home-brew IBM-based printer, I suggest you read Sheila Clarke's article, "What's Happening with the IBM Selectric?" in *Kilobaud*, May 1978. If you are like me, you don't have a corps of engineers available for technical consultation. And, finally, I didn't have the time to either tackle the modification or to iron out the bugs, which would, no doubt, breed at an exponential rate.

Other IBM-based used or rebuilt Selectrics with ASCII boards are available from other retailers, and some of them are slightly less expensive than the reconditioned AJ-841, but the ads on these alternative systems are not clear as to what is required in terms of hard-wiring to the TRS-80 or in terms of software requirements as in Emerson Brooks' system. Even additional brochures and other printed materials from some advertisers were not clear in telling me what would be involved in adapting their printers to the TRS-80.

As for the AJ-841, I knew the system was compatible with the TRS-80 because the folks at Microtronix had already made

LOGIC BOARD JUMPERS SET AT "P" & "T"   POWER SUPPLY BOARD   SOLENOID DRIVER BOARD

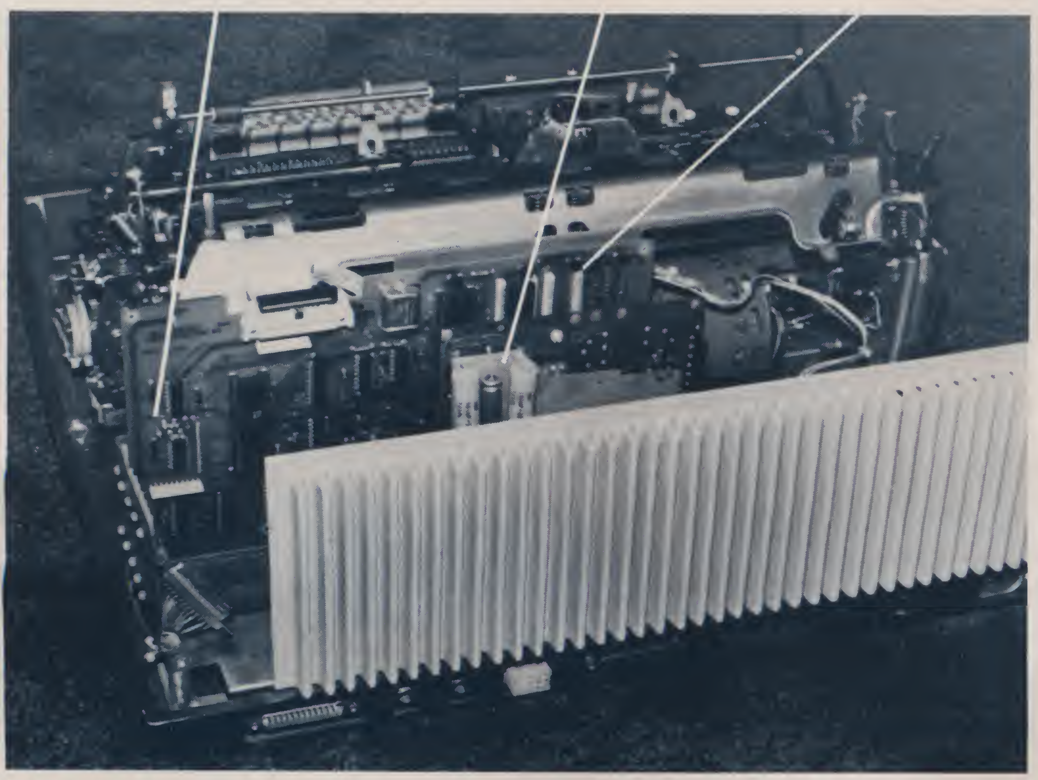

Photo 2. Back view of the AJ-841 PC board and mechanics.

the conversion. In fact, Phil Aiken at Microtronix was instrumental in helping me get my system working. Initially, I didn't know how to wire the connecting cable between the AJ-841 and the TRS-80, but I saw the Microtronix ad that advertised the AJ-841 ready to go with the TRS-80. So I called Microtronix and Phil was extremely helpful in providing me with the necessary guidance. Furthermore, I have made some retail purchases from Microtronix and am very satisfied with their service. I would recommend them to anyone.

In summary, I knew that the AJ-841 was compatible with the TRS-80, but I was less certain about the other IBM-based printers. All the AJ-841 requires is a cable made in accordance with the directions provided in Fig. 1, and it can still be used as an off-line typewriter.

Finally, as a factory reconditioned terminal, the AJ-841 is considerably less expensive than other typewriter-quality printers such as the Qume, Diablo, Selecterm or whatever.

My next project is to learn how to utilize the input capability of the AJ-841 with my TRS-80. This input capability is another feature that is not available on several of the other IBM typewriter systems. I hope to make this project the subject for future discussion. ■

TRS-80 Edge Connector Pin Number and Label	AJ-841 Pin Number and Label
1 (Strobe)	9 (DXSTRB)
3 (D0)	1 (D0)
5 (D1)	2 (D1)
7 (D2)	3 (D2)
9 (D3)	4 (D3)
11 (D4)	5 (D4)
13 (D5)	6 (D5)
15 (D6)	7 (D6)
20 (Ground)	21 (Ground)
21 (Busy)	10 (DXACK)

Additional Instructions:

1. Leave D7 from the TRS-80 disconnected.
2. On the cable coming from the TRS-80, tie line 22 to 23 and tie lines 25, 26 and 28 together. (Don't connect them to anything—just tie them as stated.)
3. On the AJ-841 logic board (see Photo 1), put the jumpers at P and T.

Fig. 1. Connecting-cable connections.

Some Thoughts on the SWTP Computer System

The first installment of this ongoing series appeared back in March. Here's number 2.

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This is the second in a series of articles on the SWTP 6800 computer system. I trust you are finding them as interesting to read as I am finding them interesting to write.

A Strange Bug in the Heath H9

If you are using the Heath H9 CRT terminal with your SWTP 6800 computer, you may already have run across this strange problem, but then again, perhaps you haven't . . . yet.

Sometimes, just after the H9 executes a carriage return or prints a character, it outputs a short, unexpected 0 pulse on its keyboard output. Although short, it is of long enough duration so that it is interpreted by an MP-C interface as a character start pulse. Hence the MP-C starts to receive a character, which is not really there, from the H9. This character contains all ones and is a hex $7F, a rubout.

Some of the standard SWTP software includes a test for rubout and ignores it. For instance, in SWTP 8K BASIC version 2.0, the test is at 03C8 and looks like this:

```
03C8  81  7F  CMP A  #$7F
03CA  27  F1  BEQ    AGAIN
```

That there is an extra rubout doesn't bother it at all.

But other SWTP programs may not check; for instance, the CORES editor/assembler does not. Sometimes it does strange things when it is used with an H9, that is, when extra rubout characters get mixed into your text. Program 1 is a patch for CORES to delete rubouts in the input in case you need it. In machine-language programs you write, make sure you include such a rubout test if at all possible.

Actually, in some programs this may pose quite a problem. I recently ran across a program that contained the following steps:

```
LDX  #TEXT
JSR  PDATA
JSR  BADDR
```

The first two lines print a message, and the third goes to the BADDR routine in the monitor to get a four-digit hex number from the keyboard.

BADDR accepts only hex digits as input; if a non-hex character is entered, it returns to the monitor. What was happening in our case was that every single time we performed this segment, the program would bomb and return to the monitor. It turned out that the H9 output a rubout after the carriage return in the message, and so BADDR was receiving a non-hex character.

To save the program, we have only a few choices: We can include a time delay before the JSR BADDR to allow the extra start bit to go by, or we can write our own BADDR routine to include a rubout test.

This is definitely a bug, albeit an interesting one, in the H9. Although the start pulse comes out of the H9, it can be set off by external events.

For instance, I found that several H9 terminals output this false start pulse while the computer was outputting to them. This is not usually a problem, unless you have the H9 paralleled with another terminal, since the H9 will then insert rubouts into the text coming into the computer from the other terminal's keyboard. So if you are getting strange results when you use the H9 on your SWTP system, you may want to look into this problem.

Program 2 may be of some help. It accepts five characters input from the keyboard and then prints out the five hex ASCII codes for those characters. In normal operation you hit five keys on the keyboard, after which the computer sends back the five characters and their ASCII codes. If your H9 has this same problem, then the ASCII data will start coming out after only three or four keys are pressed and will contain extra $7F codes. This program is also useful if you have unlabeled keys on the keyboard and want to know what codes they produce.

Paralleling Terminals

If you have two terminals—a CRT terminal and a teleprinter, for instance—that you would like to connect to the same port at the same time, here is how to do it.

If both are current loop interfaced, simply connect the two keyboards in series and the two printers in series. You may have to reduce the value of R10 in the interface to maintain a printer current of 20 mA and get reliable output.

If both terminals use an EIA RS-232C interface, the two printers can be connected in parallel to the same port output. But the two keyboards should not be paralleled since they will load each other down. Instead, use isolation diodes as shown in Fig. 1.

If you have one current loop and one EIA terminal, you can connect them to an MP-S or MP-C in the normal way. Just omit

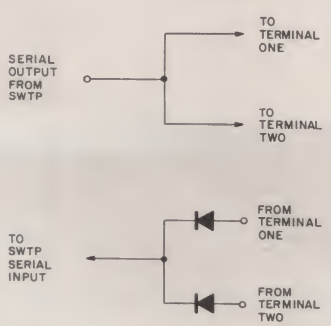

Fig. 1. Connecting two terminals to one computer.

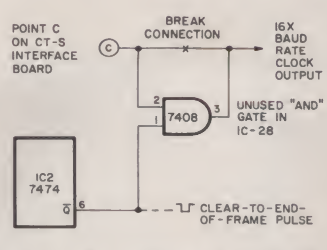

Fig. 2. CT-1024/CT-64 modification. (Diagram courtesy of Bobby E. Dunsmore, Oklahoma City OK)

```
                NAM    PATCH
                OPT    0,NOP
        ****************************************
        *CORES PATCH TO DELETE RUBOUTS ON INPUT
        *  PETER A. STARK 12/08/ 8
        ****************************************
        *FIRST MAKE ROOM FOR THE PATCH BY MOVING
        *START OF SOURCE PROGRAM
00FE            ORG    $00FE
00FE 1B90       FDB    $1B90
        *
        *ACTUAL PATCH
1B80            ORG    $1B80
1B80 BD E1AC RUBPAT JSR $E1AC    GO TO INEEE
1B83 81 7F      CMP A  #$7F      IS IT RUBOUT?
1B85 27 F9      BEQ    RUBPAT    GET ANOTHER CHARACTER IF YES
1B87 39         RTS              RETURN IF NOT
        *
        *JUMPS TO PATCH
1620            ORG    $1620
1620 BD 1B80    JSR    RUBPAT
19BE            ORG    $19BE
19BE BD 1B80    JSR    RUBPAT
19C5            ORG    $19C5
19C5 BD 1B80    JSR    RUBPAT
                END
```

Program 1. Patch for CORES to eliminate rubouts on input.

the TI-TC and RI-ground jumpers you would use with just one terminal.

Bugs in the SWTP CT-1024 and CT-64 Terminals

The Heath H9 isn't the only unit with bugs; the CT-1024 and CT-64 have some too. My CT-64 has three of them:

1. When the letters pr appear together in certain spots on the screen, the p prints perfectly, but I get two r's, one on top of and slightly below the other. This is caused by the circuit that extends that lower end of the p below the line; it tries to do the same to the r right after it.

2. Occasionally control characters print on the screen, although the Control Character Print switch is off.

3. Often a line is not completely erased when being scrolled off the top of the screen and reappears instead at the bottom, either along with or instead of the new line being added.

The first problem appears unique to my own terminal, and I will have to go after it . . . someday. But the scrolling and erasing problem is more common, especially at 1200 baud. The problem is essentially due to the terminal's needing more time than it has at 1200 baud to erase the screen. The solution is to give it more time by delaying the computer output slightly. This can be done either with hardware or software.

The hardware solution has been suggested by Bobby E. Dunsmore of Oklahoma City OK. It consists of the following changes:

1. Remove the wire from point C on the serial interface board and connect it to pin 3 of IC28.

2. Run a wire from point C on the serial board to pin 2 of IC28.

3. Run another wire from pin 1 of IC28 to pin 6 of IC2.

4. Feed the terminal's clock from IC28, pin 3 to the computer and cassette interface and use it instead of the computer's baud rate clock.

Fig. 2 shows the circuit in which the baud rate clock inside the CT-64 or CT-1024 is gated in an unused AND gate in IC28 with a negative-going pulse from pin 6 of IC2. Whenever the terminal performs a "clear to end of frame" operation, this pulse turns off the clock to both the terminal and computer until the clearing is done. This gives the right time delay.

Another way to provide the delay is with a software fix. Program 3 shows OUTDEL, a short routine to provide the required delay. Instead of going directly to OUTEEE, redirect all of your programs to OUTDEL; this version is shown assembled at $B000, but you can place it anywhere in memory. This version simply puts a short time delay after every line feed ($0A) and home/erase ($10) character. This does slow down the output to below 1200 baud, but the result is not adversely affected. One bad side effect, however, is that if the computer is in the wait loop at the exact instant you hit a control-C to get out of BASIC, it may not stop. You may have to hit control-C several times.

Back Space on the CT-64

On the right side of the CT-64 keyboard are two keys that are not connected; one of these is labeled Back Space and the other is blank. They can be hooked up for special functions without too much effort.

The keyboard encorder chip is an AY-5-2376, which can handle up to 88 keys. A good description of this IC and its uses is contained in Don Lancaster's *TV Typewriter Cookbook*, available through many electronics stores. Page 36 of the book shows the diagram.

If you remove the keyboard from the terminal and connect the Back Space switch to pins 26 and 36 of the 2376, it will generate a back space (control-H or $08) code. While you are at it, you may want to modify your SWTP BASIC to accept control-H as back space instead of con-

```
                         NAM   H9-TEST
                  *PROGRAM TO CHECK OUTPUT OF HEATH H-9
                  *P. STARK, 10/6/78
                         OPT   PAG
1000                     ORG   $1000
1000 CE 10 3B     START  LDX   #BUFF      GET BUFFER ADDRESS
1003 8E A0 42            LDS   #$A042     INITIALIZE STACK POINTER
1006 C6 05               LDA B #5         INITIALIZE COUNTER
1008 8D 23               BSR   PCRLF      PRINT CR/LF
100A BD E1 AC     LOOPS  JSR   $E1AC      GO TO INEEE
100D A7 00               STA A 0,X        STORE CHARACTER
100F 81 03               CMP A #$03       IS IT CONTROL-C?
1011 27 25               BEQ   GOSWAT     YES, RETURN TO SWATBUG
1013 08                  INX              INCR INDEX
1014 5A                  DEC B            DECR COUNTER
1015 26 F3               BNE   LOOPS      REPEAT IF NOT DONE
1017 CE 10 3B     PRINT  LDX   #BUFF      PRINT RESULTS: GET BUFF ADDRESS
101A C6 05               LDA B #5         INITIALIZE OUNTER
101C 8D 0F        LOOPP  BSR   PCRLF      PRINT CR/LF
101E A6 00               LDA A 0,X        GET CHARACTER
1020 36                  PSH A            SAVE IT
1021 BD E0 CA            JSR   $E0CA      GO TO OUT2HS TO PRINT HEX CODE
1024 32                  PUL A            GET CHARACTER
1025 BD E1 D1            JSR   $E1D1      GO TO OUTEEE TO PRINT IT
1028 5A                  DEC B            DECR COUNTER
1029 26 F1               BNE   LOOPP      REPEAT UNTIL DONE
102B 20 D3               BRA   START      OTHERWISE DO OVER
102D 86 0D        PCRLF  LDA A #$0D       PRINT CR
102F BD E1 D1            JSR   $E1D1
1032 86 0A               LDA A #$0A       PRINT LF
1034 BD E1 D1            JSR   $E1D1
1037 39                  RTS              RETURN
1038 7E E0 D0     GOSWAT JMP   $E0D0      RETURN TO SWATBUG
103B              BUFF   RMB   5
A048                     ORG   $A048      SET PC ADDRESS
A048 10 00               FDB   START
                         END
        NO ERROR(S) DETECTED
```

Program 2. Checks the output of a terminal.

trol-O. To do this in 8K BASIC version 2.0, change location 0154 to 08 and location 0155 to 00. (If you have a different version, consult your manual for the appropriate addresses.)

The unmarked key in the lower right corner of the keyboard can be wired to generate several missing characters. For instance, connected between pins 27 and 36, it will provide the at sign (@) and a backward slash (\). Between pins 31 and 38, it will generate a control-P for erasing the screen. Hooked up to pins 21 and 36, the key will provide the rubout. Various other combinations are possible; get the 2376 spec sheet from General Instruments or Don Lancaster's book.

Capsule Review of the H9 and CT-64

Heath's H9 and SWTP's CT-64 terminals are both about the same price and clearly compete with each other. Having used them both, I can comment and compare these two inexpensive terminals.

The Heath terminal is a single unit containing all the circuitry and a 12-inch monitor as well; it costs $530, mail order. The SWTP CT-64 contains no monitor, but SWTP sells a CT-VM monitor in a matching case, which sits on top of the CT-64 in normal use. The two together cost $500. They are not attached, but are connected with a single cable and are easily separated.

The CT-64 can be purchased separately for $325 and used with a standard monitor, modified TV set or a standard set with an rf modulator. (At the time of this writing, SWTP has introduced a new $800 terminal, the CT-82, and it is possible that the CT-64 will be discontinued and/or sold at large discounts.)

In terms of professional looks, the Heath H9 is a clear winner. By contrast, the SWTP CT-64 looks somewhat clumsy and homemade. As with many SWTP products, the screw holes in the case do not line up well with the chassis, and the assembly is a bit flimsy. But it does look better in the flesh than it does in SWTP photos.

The CT-64 is also much smaller and lighter; with its separate video monitor, you can carry each piece separately. The single-case H9 is big and bulky.

Though the CT-64 screen is smaller than the H9's, it is much sharper. The CT-64 display is crystal clear; the H9 is fuzzy and dark. Moreover, H9 characters occupy less screen space, so that overall they are about the same size as those of the CT-64. The CT-64 is easier and more pleasant to read. If you get a different monitor, you can get a larger screen and possibly save some money as well. But I really like the CT-VM monitor that SWTP sells for the CT-64.

The H9 display is 12 lines of 80 characters; the CT-64 has 16 lines of 64 characters. Although there have been some modifications published for adding another 12 lines to the H9, I suspect that the screen will then be too crowded vertically. It's a toss-up as to which is better—I prefer having more lines even if they are shorter. Twelve lines are definitely not enough.

The H9 also has a short-line mode that breaks up the screen into four columns of 20-character lines. This can be very useful for scanning the contents of memory locations. I have found, though, that this mode is only useful if all computer output fits these short lines. If there is an occasional long line, then the H9 display will be quite confusing.

The H9 also has a graphics mode. But it is only good for plotting graphs, such as those of voltage waveforms. It cannot be used for plotting several curves or any curve that has to bend back over itself. The resolution is extremely poor, and the graph consists of underlines rather than points. My own feeling is that it is of very limited use.

The CT-64 has full uppercase and lowercase, while the H9 is uppercase only. The H9 display can be modified to include lowercase, but I believe that it is quite difficult to modify the keyboard. On the other hand, the CT-64 keyboard is missing a few characters, such as the at sign or backward slash. But these can be added, as I mentioned above.

The H9 has a row of control keys, including screen and line erase, selectable scrolling, selectable automatic carriage return at the end of a line, choice of line length or graphics and several others. These are handy, but I have found that strangers tend to play with them, and I always find the keys in the wrong positions when I need them. The CT-64 has a much more limited range of controls.

One big complaint is that the H9 carriage return key is a small one, buried in the midst of a batch of other keys. I always have trouble finding it and keep hitting other keys instead. The CT-64 return key is larger and well placed.

The CT-64 can operate at a maximum of 1200 baud and, even at that speed, tends to sometimes miss characters. The H9 can operate up to 9600 baud. Moreover, the CT-64 does not have an external baud rate switch, while the H9 does. There is room to add a switch on the CT-64, but it is not supplied. In many applications, the CT-64 upper speed of 1200 baud is a definite disadvantage.

The CT-64 has a very handy switch that enables the display of control characters. Each control character is shown as a two-letter code, such as LF, CR NU or BS. This is very handy for debugging purposes or to see what your software is doing.

The CT-64 has an internal decoder that decodes all control codes. Of these, some, such as control-G or control-H, are dedicated for special functions, and some are decoded but not used. They can be used to control external functions. For instance, SWTP uses these control signals to control cassette recorder motors used with the AC-30 cassette interface. This can not be done with the H9.

Both terminals hide the on-off switch on the back. Both terminals provide EIA RS-232C

```
                      NAM    OUTDEL
                      OPT    0
               *DELAY PROGRAM TO GIVE CT-64 OR CT-1024
               *TIME TO ERASE, RETURN, ETC.
               *P. STARK, 11/8/78
B000                  ORG    $B000
B000 37        OUTDEL PSH B         SAVE ACC B
B001 F6 A04C          LDA B  PREV   GET PREVIOUS CHAR
B004 C1 0A            CMP B  #$0A   IS IT LF?
B006 27 04            BEQ    DELAY  DELAY IF SO
B008 C1 10            CMP B  #$10   IS IT SCREEN ERASE?
B00A 26 0C            BNE    PRINT  NO, SO GO TO PRINT
B00C FF A04A   DELAY  STX    SAVEX  YES, SO SAVE INDEX AND DELAY
B00F CE 1000          LDX    #$1000 SET UP DELAY LOOP
B012 09        WAIT   DEX
B013 26 FD            BNE    WAIT   LOOP UNTIL DONE
B015 FE A04A          LDX    SAVEX  RESTORE INDEX
B018 B7 A04C   PRINT  STA A  PREV   SAVE CHARACTER
B01B 33               PUL B         RESTORE ACC B
B01C 7E E1D1          JMP    OUTEEE
               *DATA IN SWTBUG RAM
A04A                  ORG    $A04A
A04A 0002      SAVEX  RMB    2
A04C 0001      PREV   RMB    1
     E1D1      OUTEEE EQU    $E1D1
                      END
```

Program 3. OUTDEL program to give the CT-64 or CT-1024 time to erase.

connections, but neither provides the standard 25-pin connector. Heath uses their own nonstandard connector, which matches their H8 computer; SWTP provides a cutout on the back for the standard 25-pin EIA connector (not supplied).

The design of the CT-64 is fairly clear-cut, while the design of the H9 is quite sophisticated. The CT-64 is a basic, simple terminal; the H9 has a number of features, such as graphics. But the relative simplicity of the CT-64 is preferable, in my mind. It should be easily serviceable, while the H9 has complex circuitry that is not always easy to understand. It depends on several ROMs for its control functions and requires a different level of competence to do a good service job.

```
                    NAM    FASTYP
              *FASTYPIST OUTPUT FOR SWTP BASIC V2.0
              *OPERATES THROUGH PORT 7
              *P. STARK 10/19/78
E1D1          OUTEEE EQU   $E1D1
7FD4                 ORG   $7FD4
7FD4 81 0D    FASTYP CMP A #$0D
7FD6 27 08           BEQ   PRINT    CR IS OK TO PRINT
7FD8 81 20           CMP A #$20
7FDA 25 21           BCS   DONE     SKIP OTHER CONTROL CHAR
7FDC 81 60           CMP A #$60
7FDE 24 1D           BCC   DONE     SKIP LOWER CASE CHAR
7FE0 FF 7F FE PRINT  STX   SAVEX    PRINT SLOW: SAVE INDEX
7FE3 CE 10 00        LDX   #$1000
7FE6 09       DELAY  DEX            DELAY A MOMENT
7FE7 26 FD           BNE   DELAY
7FE9 36              PSH A
7FEA BD E1 D1        JSR   OUTEEE   PRINT CHAR
7FED 32              PUL A
7FEE 81 0D           CMP A #$0D     WAS IT A CR?
7FF0 26 08           BNE   GETX     NO, SO RESTORE INDEX & EXIT
7FF2 86 05           LDA A #$05     WAIT SOME MORE AFTER CR
7FF4 09       DELAY2 DEX
7FF5 26 FD           BNE   DELAY2
7FF7 4A              DEC A
7FF8 26 FA           BNE   DELAY2
7FFA FE 7F FE GETX   LDX   SAVEX    GET INDEX
7FFD 39       DONE   RTS            RETURN
7FFE          SAVEX  RMB   2        INDEX STORAGE
              *SET UP JUMP FROM PORT 7 TO FASTYPE
0145                 ORG   $0145
0145 7E 7F D4        JMP   FASTYP
              *REMOVE TEST FOR PLUGGED-IN INTERFACE
121B                 ORG   $121B
121B 20              FCB   $20
              *MAKE ROOM FOR FASTYPE AT TOP OF MEMORY
0C41                 ORG   $0C41
0C41 7F D4           FDB   FASTYP
0044                 ORG   $0044
0044 7F D3           FDB   FASTYP-1
                     END
     NO ERROR(S) DETECTED
```

Program 4. FASTYP patch for SWTP 8K BASIC version 2.0.

I also suspect that SWTP screens their incoming components better. We've built six H9s where I work and had multiple troubles with each one. There were numerous defective components, mislabeled parts and breaks on the printed circuit boards. The CT-64 does not seem to be nearly as plagued by poor quality control.

In terms of construction, the CT-64 is also simpler. Most of its guts are on one large printed circuit board, with several smaller boards that plug into it; there are relatively few wires strung between them. The H9, on the other hand, has a large cable harness connecting several smaller boards scattered throughout the chassis. There is a lot of chassis wiring to do.

Another consideration is that the CT-64's video monitor comes assembled; the video portion of the H9 takes up a considerable amount of time to mount and wire.

The H9 construction manual is a typical Heath masterpiece. By comparison, SWTP's CT-64 construction manual is deficient. It's badly organized and actually consists of several smaller manuals; it's hard to tell just how they fit together.

Put another way, you can work on the Heathkit at 2 o'clock in the morning with one eye closed, but you have to be wide awake to follow the SWTP manual. Heath shows every board and its parts in several views and tells you about every wire; SWTP shows only one parts placement diagram for each board and requires that you look up the value of each part on the parts list to mount it. Moreover, SWTP instructions essentially say, "Mount all the resistors. . . . Mount all the capacitors. . . ."

But you can overlook this when you consider that the SWTP unit is simpler and hence requires less intricate work than the Heath requires. And I suspect the SWTP is more likely to work without extensive troubleshooting when you're finished.

The SWTP unit is less expensive than the Heath—even if you pay someone to build it for you, it may not be much more expensive. In particular, many computer stores have either personnel who build kits or bulletin boards listing people willing to do it. My unit was purchased wired from Lehigh Computer Works, 1132-2 Tilghman St., Allentown PA 18102, which built it for a very reasonable additional amount.

PR-40 Ribbons, Etc.

PR-40 ribbons can be ordered from Addressograph-Multigraph Corp., part number 116-2395-326. If your PR-40 makes strange sounds and produces letters that are sometimes narrow and sometimes wide, perhaps it needs some grease on the cam. Mine did. See the power supply fix for C1 in Part 1 (March 1979, p. 58).

Compatibility of Cassette Tapes

Now that new software for the SWTP system is being produced by numerous companies, there is a problem of incompatible tapes. For instance, CORES source tapes cannot be read by the TSC Editor and Assembler used on cassette systems or on the SWTP disk system under FLEX, and vice versa. It's not just a matter of the language being a little different—the control characters and tape format are different.

But there is one format that all of these systems accept—that used when you sit at the keyboard and type in . . . fairly slow, no control characters and carriage returns, not line feeds, separating lines. Since the cassette interface of the SWTP comes in through the same port as the keyboard, all we have to do is reformat tapes to look like human input, although possibly somewhat faster, to the computer.

The result is what some people call the "fastypist" format . . . faster than a human, but still slow enough so that the computer can insert whatever control characters it needs. This format has no line feeds or other control characters other than carriage returns. It also has a lengthy delay after the carriage return to allow the computer to echo a line feed and a few nulls, and perhaps place the line in line-number order.

There are several ways to format your tapes this way. One is

```
                        NAM   FASTYP-2
                 *FASTYPIST - CONVERTS ANY FORMAT TAPE INTO
                 *FASTYPIST-FORMAT TAPE
                 *P. STARK 10/19/78
E1AC             INEEE  EQU   $E1AC
E1D1             OUTEEE EQU   $E1D1
E0D0             SWATBG EQU   $E0D0
0100                    ORG   $0100
                 *
                 *THE FOLLOWING PART READS THE TAPE
                 *
0100 CE 01 54    FASTYP LDX   #TEXT
0103 BD E1 AC    READ   JSR   INEEE
0106 81 0D              CMP A #$0D
0108 27 08              BEQ   STORE      CR IS OK TO STORE
010A 81 20              CMP A #$20
010C 25 F5              BCS   READ       SKIP OTHER CONTROL CHAR
010E 81 60              CMP A #$60
0110 24 F1              BCC   READ       SKIP LOWER CASE CHAR
0112 A7 00       STORE  STA A 0,X        STORE IN MEMORY
0114 08                 INX
0115 FF 01 4E           STX   LAST       STORE NEXT EMPTY ADDRESS
0118 BC 01 52           CPX   MLIMIT     MEMORY FULL?
011B 26 E6              BNE   READ       NO, SO RETURN
011D 7E E0 D0           JMP   SWATBG     YES, SO EXIT
                 *
                 *THE FOLLOWING PART OUTPUTS THE TEXT
                 *
0120 CE 01 54    OUTPUT LDX   #TEXT      GET ADDRESS OF TEXT START
0123 FF 01 50    OLOOP  STX   NEXT       SAVE ADDR OF NEXT CHAR
0126 CE 10 00           LDX   #$1000
0129 09          DELAY  DEX              DELAY A MOMENT
012A 26 FD              BNE   DELAY
012C FE 01 50           LDX   NEXT
012F A6 00              LDA A 0,X
0131 BD E1 D1           JSR   OUTEEE     PRINT CHAR
0134 A6 00              LDA A 0,X
0136 81 0D              CMP A #$0D       WAS IT A CR?
0138 26 08              BNE   INCRX      NO, SO INCREMENT X AND CONTINUE
013A 86 05              LDA A #$05       WAIT SOME MORE AFTER CR
013C 09          DELAY2 DEX
013D 26 FD              BNE   DELAY2
013F 4A                 DEC A
0140 26 FA              BNE   DELAY2
0142 FE 01 50    INCRX  LDX   NEXT       GET POINTER TO NEXT CHAR
0145 08                 INX              INCREMENT
0146 BC 01 4E           CPX   LAST       ALL DONE?
0149 26 D8              BNE   OLOOP      NO, SO CONTINUE
014B 7E E0 D0           JMP   SWATBG     YES, SO EXIT
014E             LAST   RMB   2          ADDR OF NEXT EMPTY MEM LOCATION
0150             NEXT   RMB   2          ADDRESS OF NEXT CHARACTER
0152 80 00       MLIMIT FDB   $8000 LIMIT OF MEMORY SIZE
0154             TEXT   RMB   1
                 *SET PROGRAM COUNTER
A048                    ORG   $A048
A048 01 00              FDB   FASTYP
                        END
     NO ERROR(S) DETECTED
```

Program 5. Tape-to-tape FASTYP.

to patch your program to produce this output directly; another is to write a program that will re-format an existing tape. Programs 4 and 5 show the two approaches.

Program 4 is a patch for SWTP 8K BASIC version 2.0, which substitutes a fastypist *routine* for the printer routines on port 7. This version is assembled to lie at the very top of memory for a 32K system, from 7FD4 to 7FFF; it can be loaded after BASIC and its source program are in memory. It is easily moved down for smaller memories, or up if you have a larger system.

To use the patch, simply tell BASIC to LIST#7, start the tape and then hit return. It will be recorded in the fastypist format. The patch makes three changes to BASIC to set up the jump and make sure that BASIC does not erase it.

The jump at location 0145 sets up the jump from BASIC into the fastypist routine after an output to port 7. The BRA or 20 inserted at 121B defeats a test in which BASIC checks to make sure that an interface is really plugged into port 7 before accepting the LIST#7 command. If you really have an MP-L plugged into port 7, you will not need this step.

When BASIC first starts up, it stores $55 into each memory location above itself and then reads it back to see if it went in properly. This is how it finds out how much memory your system has. Normally, location 0C41 has the address 8000, and BASIC stops checking when it gets there. If you ran this, BASIC would erase the fastypist patch. By placing the starting address of the fastypist routine into 0C41, we stop the memory-checking routine there. We then store one less than that into location 0044, which tells BASIC the last available address.

Program 5 shows a complete program that reformats almost any format tape into a fastypist tape. It starts at 0100 and goes up to 0153. The first part of the program reads the tape, strips off all lowercase letters and control characters other than the carriage return and stores the rest in memory. Before running it, set MLIMIT to one more than the last address you have; it is now set to $8000 for a 32K system.

When the tape is done, reset the computer and start the second part of the program at OUTPUT. Fastypist will now output the text at the slower speed required. To read fastypist tapes back in, just make believe you are typing but turn on the cassette interface instead. Your program will never know the difference.

One last comment: Because of a hardware conflict, fastypist tapes will not read on the otherwise excellent Percom CIS-30+ interface. I will explain why later in this series of articles, when I review four cassette interfaces for the SWTP system.

More BASIC Patches

There are numerous patches you might make to BASIC for various other functions, and some have been published in *Kilobaud*. For instance, the idea used in Program 3 above of limiting the size of the memory BASIC uses was written in a recent issue by Dexter French of Longwood FL (see "Letters," October 1978 *Kilobaud*, p. 21).

Dale Puckett ("String Expansion for SWTP's BASIC," July 1978 *Kilobaud*, p. 68) recently wrote another patch for SWTP 8K BASIC version 2.0, which allowed changing the string length by changing the hex

```
03A3   B6   8004   LDA A   $8004   DOES ACIA HAVE ANYTHING?
03A6   47          ASR A
03A7   24   11     BCC     NO      IF NO CHARACTER
03A9   DF   8A     STX     $008A   YES, SAVE INDEX REGISTER
03AB   DE   90     LDX     $0090   GET CURRENT PORT ADDRESS
03AD   BD   E1AC   JSR     $E1AC   GET THE CHARACTER
```

Program 6.

number in location $003E. It is currently at $20 for 32 characters but can be changed to anything from 7 to 72. Dale's suggestion was that it can easily be changed with a POKE(62,) statement. But be sure to do it only once in a program, that is, at the very beginning.

Despite what SWTP says in their SWTBUG manual, 8K BASIC version 2.0 can be changed to run with the MP-S serial terminal. The patch you need to make is shown in Program 6. This is part of the routine that looks for a control-C character for a break. Once you make this change, BASIC will not work with the MP-C interface. My thanks to Tom Quay of the above-mentioned Lehigh Computer Works for this patch.

Another patch you may not have seen yet is for SWTP 8K BASIC version 3.0 (the FLEX disk version), which fixes the problem with the RESTORE command:

```
13DD  92
205C  09
2060  05
```

If you are using Cassette Super BASIC from Computerware Software Services, 830 First Street, Encinitas CA, and have 32K of memory, you may have noticed that this BASIC only uses 26K or 28K of it to leave room at the top for a disk operating system if you have one. If you don't, then you may want to patch the BASIC so it uses the space up to $7FFF. In version 1.0 change location 010C from 70 to 80; in later versions the address is 010D and should be changed from 68 to 80.

Another function is to renumber BASIC lines. Island Computers, St. James City FL, offers a BASIC line renumberer program, which is actually written in BASIC itself, using line numbers 9900 through 9988. It is intended for SWTP 8K BASIC version 2.0. But note: It only renumbers the lines themselves; it does not update line numbers in GOTO or GOSUB statements. A more complete renumberer, called RENBAS, is available from Computerware Software Services.

The January 1979 Issue of *Kilobaud MICROCOMPUTING* ("An Editor for 6800 BASIC Programs," p. 22) describes my own version of a renumberer/editor called BASEDIT. Editing allows global replacement of strings and searching for certain strings. Renumbering a program changes each line number and also updates all references inside GOTO, GOSUB, IF and ON . . . GOTO statements.

BASEDIT does not work on a BASIC source program while it is in memory with the interpreter. It is designed to read a BASIC source tape, edit it and then write out a new tape. You can probably think of many changes you'd like to make to BASIC, but the problem is finding out enough about the BASIC to know how to do it. Although you can get a fairly good idea of how BASIC works if you disassemble it and spend a few weeks studying the resulting 72 or so pages, it is certainly not easy.

But now somebody has finally done something about it. SSI, 4327 Easy Grove Street, Phoenix AZ 85040, publishes *A Companion to Robert Uiterwyk's BASIC Interpreters* by Dave Gardner. It outlines the major memory locations used in the various MSI and SWTP BASICs Robert Uiterwyk has authored, explaining what they do. Dave also presents 34 additions or patches you can make.

The BASICs covered are MSI version 1.2, SWTP 4K version 2.0, 8K version 2.3 and disk version 3.0. The book lists 72 locations and entry points in the BASICs and explains what they do.

Among the modifications and additions, one simple change makes BASIC print out the number of the line it was doing before it was stopped with a control-C. Another added command causes printout of how much memory is taken up by the BASIC program, its variables and string and stack buffers. Another implements an ON ERROR GOTO statement, which allows programs to recover from errors without stopping.

All in all, it's a very useful book; I'm waiting for Dave Gardner's next offering.

Punching a diskette for double-sided use.

A 6800 Newsletter

'68' Micro Magazine, a monthly newsletter for 6800 users (actually, it will also be for users of the 6802, 6809 and other Motorola 6800-family processors) started publication early this year. Mickey Ferguson, a *Kilobaud* regular and 6800 expert, and Dennis Womack, another 6800 expert, are working on it, so it's definitely worth reading.

They plan articles on how to adapt the MF-68 disk and FLEX to the Sphere computer, how to modify BASIC to allow longer variable names, modifying the A/BASIC compiler to work with the SWTP MP-N calculator interface and various reviews of new and old equipment. They also plan to print a number of application programs. For further information, write to *'68' Micro* at 3018 Hamill Rd., Hixson TN 37343.

Selectric Parts and Golf Balls

One thing I love about my SWTP system is the ease with which I can interface other hardware to it. I am using a Dura 1041 Selectric typewriter terminal, interfaced to an MP-L card, to prepare this article. I wouldn't be surprised if some readers had a similar setup. If you need Selectric parts or interfacing information, I have found Kelly Data, 20589 S.W. Rosa Dr., Aloha OR 97005, very helpful. They also sell maintenance manuals and all sorts of tools.

Broken golf balls? I'm referring to the little bouncing balls that the Selectric typewriter uses as typing elements. If you have one with cracked teeth, a broken stem or a broken top, you can get it repaired by DSG, Inc., 1737 Chestnut Street, Philadelphia PA 19103. They also sell new ones and provide quick service.

Two-sided Disks

SWTP has just lowered the price of their MF-68 mini-floppy dual disk system. You've probably noticed that. But a less known change is that they are now supplying it with Wangco model 82 disk drives instead of the Shugart SA400 drives they used before. Aside from the fact that it looks different, the Wangco drive has two mechanical changes. First, instead of 35 disk tracks, it allows the use of 40; this means that with a slight change in programming the Wangco drive has a seventh more storage than the older drives. (More on this in a future article.)

The second interesting change is that the Wangco drive has two optical hole sensors and two file-protect sensors instead of one. Now you can put the diskette in upside down and write on the back of the disk as well as the front. This gives you twice the storage on every disk. It's not quite as good as a double-sided drive, which would let you write on

the back without pulling the diskette out and flipping it, but it's better than a single-sided one.

If you are careful and do not have slippery fingers, you can do the same with older drives too. The trick is to punch holes in the diskette cover so that it can be put in upside down. Three holes are required—two in the spot where the sector holes have to be read and a third where the write-protect switch touches the edge.

Several people have apparently had the same idea at the same time. One technique was described by Morris J. Miller in the December 1978 issue of *Kilobaud* ("Scratched Diskette?" p. 106). My technique is a little different, but the end result is the same.

I use a hand punch to punch a round hole in the diskette cover. I start by carefully marking on the black diskette cover the location of the hole, one on each side, symmetric with the sector-sensing hole it already has. To avoid scratching the disk beneath, I cut a narrow piece of slick paper into a strip, which I carefully slide into the diskette cover through the center hole, under where I want the new hole. Then I insert the hole punch and carefully punch the hole. See the photo for details.

Your hole punch must be absolutely new and sharp. The inside of the black cover is coated with a fabric layer that decreases the friction as the disk turns. If the hole punch is not sharp, tiny strands of thread will hang out and mess up the job. They are hard to remove and can become wedged between the disk and head.

You can use the same hole punch to cut a slot along the edge for the write-protect switch. But I prefer to use a tool designed to cut metal electronic chassis; it is called an Adel Nibbling Tool and makes a much more even slot.

Practice makes perfect. Be very careful, because if you ruin a few disks you will lose more than you will gain. I have punched all of my disks this way and have had no problems.

What do you do with the new disk sides? Well, how about using them for backups? A good idea is to back up disk 1 on the back of 2, and back up disk 2 on the back of 1, and so on. In this way, you will quickly remember which disk has the backup of which other disk.

Conclusion

That's all for this installment. I'll include more ideas next time, along with some more capsule reviews. If you have any suggestions or would like something included, please let me know. (Do *not* write c/o *Kilobaud MICROCOMPUTING*.) ■

✓ *Reader Service—see page 179*

5 reasons why you should not buy the electric pencil II™

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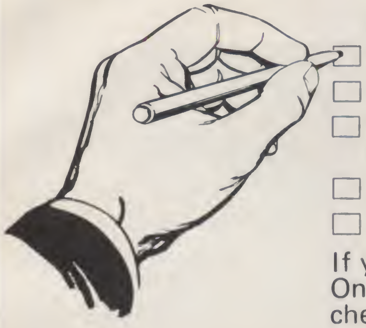


Check the appropriate box(es):

- ☐ **You love typing the same copy 20 thousand times a day.**
- ☐ **Your secretary can type 250 words per minute.**
- ☐ **You're dying to spend $15,000 on a word processing system, just for the tax investment credit.**
- ☐ **All your capital assets are tied up in a 10-year supply of correction fluid.**
- ☐ **You never commit a single thought to paper.**

If you have checked one or more boxes, you do not need The Electric Pencil. On the other hand, you may want to join the thousands of people who haven't checked a single box.

The Electric Pencil II is a *Character Oriented Word Processing System.* This means that text is entered as a string of continuous characters and is manipulated as such. This allows the user enormous freedom and ease in the movement and handling of text. Since line endings are never delineated, any number of characters, words, lines or paragraphs may be inserted or deleted anywhere in the text. The entirety of the text shifts and opens up or closes as needed in full view of the user. The typing of carriage returns or word hyphenations is not required since lines of text are formatted automatically.

As text is typed and the end of a line is reached, a partially completed word is shifted to the beginning of the following line. Whenever text is inserted or deleted, existing text is pushed down or pulled up in a wrap around fashion. Everything appears on the video display as it occurs, which eliminates guesswork. Text may be reviewed at will by variable speed scrolling both in the forward and reverse directions. By using the search or search and replace functions, any string of characters may be located and/or replaced with any other string of characters as desired.

Numerous combinations of line length, page length, line spacing and page spacing permit automatic formatting of any form. Character spacing, bold face, multicolumn and bidirectional printing are included in the Diablo versions. Multiple columns with right and left justified margins may be printed in a single pass.

Wide screen video

Versions are available for Imsai VIO video users with the huge 80x24 character screen. These versions put almost twice as many characters on the screen!!!

CP/M versions

Digital Research's CP/M, as well as its derivatives, including IMDOS and CDOS, and Helios PTDOS versions are also available. There are several NEC Spinwriter print packages. A utility program that converts The Electric Pencil to CP/M to Pencil files, called **CONVERT**, is only $35.

Features

- CP/M, IMDOS *and* HELIOS compatible
- Supports four disk drives
- Dynamic print formatting
- DIABLO and NEC printer packages
- Multi-column formatting in one pass
- Print value chaining
- Page-at-a-time scrolling
- Bidirectional multispeed scrolling controls
- Subsystem with print value scoreboard
- Automatic word and record number tally
- Cassette backup for additional storage
- Full margin control
- End-of-page control
- Non-printing text commenting
- Line and paragraph indentation
- Centering
- Underlining
- Bold face

Upgrading policy

Any version of The Electric Pencil may be upgraded at any time by simply returning the *original* disk or cassette and the price difference between versions, plus $15 to Michael Shrayer Software. Only the originally purchased cassette or diskette will be accepted for upgrading under this policy.

Have we got a version for you?

The Electric Pencil II operates with any 8080/Z80 based microcomputer that supports a CP/M disk system and uses an Imsai VIO, Processor Tech. VDM-1, Polymorphic VTI, Solid State Music VB-1B or Vector Graphic video interface. REX versions also available. Specify when using CP/M that has been modified for Micropolis or North Star disk systems as follows: for North star add suffix A to version number; for Micropolis add suffix B, e.g., SS-IIA, DV-IIB.

Vers.	Video	Printer	Price
SS-II	SOL	TTY or similar	$225.
SP-II	VTI	TTY or similar	225.
SV-II	VDM	TTY or similar	225.
SR-II	REX	TTY or similar	250.
SI-II	VIO	TTY or similar	250.
DS-II	SOL	Diablo 1610/20	275.
DP-II	VTI	Diablo 1610/20	275.
DV-II	VDM	Diablo 1610/20	275.
DR-II	REX	Diablo 1610/20	300.
DI-II	VIO	Diablo 1610/20	300.
NS-II	SOL	NEC Spinwriter	275.
NP-II	VTI	NEC Spinwriter	275.
NV-II	VDM	NEC Spinwriter	275.
NR-II	REX	NEC Spinwriter	300.
NI-II	VIO	NEC Spinwriter	300.
SSH	SOL	Helios/TTY	250.
DSH	SOL	Helios/Diablo	300.

Attention: TRS-80 Users!

The Electric Pencil has been designed to work with both *Level I* (16K system) and Level II models of the TRS-80, and with virtually any printer you choose. Two versions, one for use with cassette, and one for use with disk, are available on cassette. The TRS-80 disk version is easily transferred to disk and is fully interactive with the READ, WRITE, DIR, and KILL routines of TRSDOS 2.1.

Version	Storage	Price
TRC	Cassette	$100.
TRD	Disk	$150.

mss

MICHAEL SHRAYER SOFTWARE, INC.
1253 Vista Superba Drive
Glendale, CA. 91205
(213) 956-1593

✓S88

Demand a demo from your dealer!

✓ Reader Service—see page 179

New Life for Our Altair

It's two years later. Whatever happened to those Altairs?

Harley Dyk
Computer Math Instructor
Mona Shores High School
Muskegon MI 49441

This article is a follow-up to my June 1977 *Kilobaud* article ("Put a Micro in Your School," p. 38), which outlined the acquisition of two Altair 8800A computers (bought in the summer of 1976) to use in my computer math classes. The purchase consisted of the two computers, a CRT, a Teletype and two cassette recorders.

I should first report that the computers have done everything I anticipated. The only downtime we experienced was when BASIC would die, or a power failure would wipe it out, and loading (toggling the bootstrap loader, etc.) would take about 10 minutes. Even both of the infamous Mits ACR boards (the reportedly undependable, obsolete design) have worked flawlessly for two school years as a cassette interface. We did use premium audio tape, and each student had his own tape, which was kept in the classroom to avoid significant temperature changes and possible damage from being dropped in the sand or dirt.

The only hardware problem we encountered in two years was during the operation of a computer dating program when occasionally someone's name would lose a character. A memory test revealed that memory location 13038 on the 16K static memory board had some bad bits. Our decision to try time and materials on our system has worked out well.

The equipment was picked to accommodate an average of 25 students who had been taking the class each year. The equipment (with two on-line users) proved to be adequate the first year. However, the second year began with 47 students, and the only improvement in equipment was a Lear Siegler ADM-3A to use in place of the Teletype (ASR-33) terminal.

With this configuration, the CRTs were used most of the time and the Teletype was used only when hard copy was desired. It was also used (off line) so students could put their first version of a program on paper tape for later loading into the computer. However, we still had only two on-line terminals for 47 students. We managed only because we were fortunate that half of the students had a free hour when the computers were available, and these students were willing to work on the computer then.

Where Do We Go from Here?

The fall of 1977 found me researching what we needed to get at least two more terminals on-line. The PET and TRS-80 were available, but not enough was known about them yet and the peripheral situation was very gray at that time.

I wanted to accomplish three goals with new equipment: (1) provide two or three more on-line terminals; (2) increase the speed of program storage and retrieval; (3) increase hard-copy speed. The equipment had to be compatible with what we had. Buying two or three PETs or TRS-80s would have taken care of the first goal but left us with incompatible cassette-tape formats. It would have given us two unidentical BASICs, and the hard-copy situation was not totally clear for these systems at that time.

Time-sharing seemed a real possibility since it was available for the Altair. If you have watched the blinking lights on an Altair in a single-user system while students are entering, debugging and running programs, the computer is loafing 80-90 percent of the time. Why not run several users off the same mainframe and utilize its power?

With the equipment we had, time-sharing, a floppy disk, two more CRTs and a printer was the best way to proceed. Of course, the time-sharing system involved more I/O boards, more memory, etc. In fact, it meant an Altair with 13 full slots rather than the four we had full.

Ask and You Shall Receive

Spring 1978 found me asking for an additional $8600 worth of equipment at a school board meeting. The meeting went as well as could be expected. The purchase of the additional equipment was approved with hardly a question.

L-R: Students Tim Fullmer, Scott Fisher, Jeff Cramer, Judy Stuhan and Jeannine Vandonkelaar working on our system.
(Photo by Gary Reed)

I guess the success of the program and an almost 100 percent increase in enrollment for the class helped convince the board that we needed more equipment. Another selling point was that another user could be added to the system with only the additional cost of a terminal.

The Equipment

The printer we chose was the Texas Instruments 810. The basic model (uppercase only) sold for $1895 and handled paper up to 132 char. (tractor feed) and printed at 150 cps. This seemed the best buy in printers. It is an excellent value, if your application can tolerate the dot matrix quality. I have seen the printer advertised recently for $1695.

The disk was the new Mits 3202 dual floppy. This is their first dual floppy and, at 80 lbs, it is a sturdy piece of equipment. It seems better built than their older single drives.

After talking to several people (including people at three other installations in Michigan that were using Mits Time-sharing) and after considering the good advice of Peter Blond (owner of the Computer Store of Ann Arbor), we decided to get the dual floppy rather than a single. The ability to copy diskettes is a valuable feature, and with several users depending on the system, one drive out of alignment would leave half of the disk usable until the other half could be repaired.

I chose the Microterm ACT-IVB for the CRTs. For the same cost as the ADM-3A, the Microterm has the same features plus better cursor control, a local mode, printer port, number pad and lowercase.

Ordering and Delivery

We ordered the equipment about June 1, and I lovingly put one of our faithful 8800As in the mail to Ann Arbor for rebuilding. Peter Blond had strongly suggested that the power supply of our "A" be replaced with the "B" power supply. I guess the main reason we did not want to skimp on the power supply or disk was to forestall the 2 1/2 hours drive (by car) to Ann Arbor. (It is nice to have a reliable system . . . particularly when 45 students cry when it is not working.)

The system came about two weeks after school started, about the time the students were sick of flowcharting and watching demonstrations on our single-user system. Mits Time-sharing 1.1 (without files) had been out over a year, and was what we had ordered, but we were asked to be an Alpha test site for a preliminary version of Time-sharing 2.0 with files. Of course we agreed. The T/S 2.0 went on the market in early 1979.

Using the System

After five months of using the system, we loved it. We used to load 10.2K of BASIC in seven minutes from cassette after toggling in the bootstrap loader. The T/S BASIC 2.0 loads in about 5 seconds from the disk. An Autostart board holds the bootstrap in ROM. The T/S BASIC 2.0 occupies over 28K and is the full Extended Mits Disk BASIC complete with sequential and random files.

After the bootstrap load, the system must be initialized. At this point, the available RAM is divided among the users, the number of users (up to eight) is picked, the users are placed at priority levels, and the number of sequential and random files per user is picked.

Our system with the full 64K leaves about 36K available for the four users. After memory for buffers, string space, swap areas, etc., we are left with an average of 7.7K for each of our four users. We are presently running three users at 6.6K each and one user at 11K. You could increase the memory by using T/S 1.1, and, of course, the memory can be divided as desired at initialization time.

The T/S BASIC with the dual floppy makes a beautiful system for the students saving and loading programs. I am using two diskettes for 45 students, which allows storage of a maximum of 560 programs for a total of over 570K bytes. Obviously this averages out to a little over 1K per program, and certainly some programs will be over that, so I recommend that each student keep a maximum of seven or eight programs on the disk.

Using the same two diskettes all day allows a student to work on the system during any free

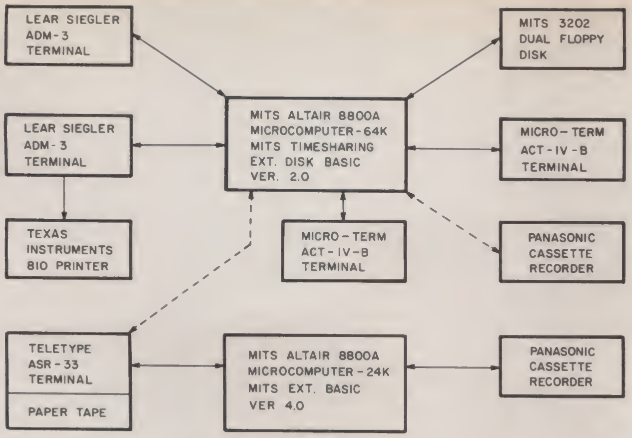


Fig. 1. System configuration.

hour or after school and have his programs available instantly. It also means the students do not have to handle the diskettes, which I believe will help in maintaining a reliable disk system. I am all for hands-on experience, but when one student can mess up a disk by improper handling of a diskette with filthy hands, thereby inconveniencing 44 other students, I draw the line.

With all students able to access the disk, some sort of protection is needed. This is provided by the T/S software, and each student must use a password to save, load and kill programs. Degrees of protection are provided so that the instructor can put programs on the system, programs that are usable by the students but cannot be killed or altered by the students.

Our system is also versatile. Besides the obvious advantages of disk, we can use cassette in the single-user mode to take old cassette programs and store them on disk in the single-user mode. Then the disk can be read in the T/S mode. The Teletype with paper tape can be switched into the T/S system (see Fig. 1) so software available on paper tape can be read in and placed on disk.

I plan to require each student to do at least one program using paper tape and one program using cassette on the single-user system with the Teletype. I think the more exposure I can give them to different storage and retrieval methods, the more valuable the class will be to them. They will truly appreciate the disk and CRTs after working on the Teletype with paper tape or cassette.

Conclusion

Is a T/S system a viable alternative or even competitive with several single-user TRS-80s or PETs? I guess that depends on the individual situation. We began choosing equipment and made our first purchase in the spring of 1976 when Mits was clearly the leader. That we had some of their equipment clearly influenced us when we were looking for more equipment.

Now that Mits has moved on to the small-business market (and does not even make kits anymore), there are many other companies and configurations to choose from. Yet an Altair 8800B with eight users, dual disk, 150 cps printer and eight CRTs can be purchased for under $2000 per user. This cost increases to about $2850 per user for four users, which is a better situation with respect to memory and response time. This can be compared to a TRS-80 4K Level II with quick printer and cassette for about $1500, or the TRS-80 16K Level II with quick printer and mini-disk for about $2300. So at the four-user level the prices are in the same ball park, and four mini-disks would not give the same storage as a full-size dual unit.

Obviously response time would be slower with the T/S system compared to the single-user configuration, but in our four-user situation, response time has been no problem. All jobs are worked on "simultaneously" (the computer works on the user's jobs in .1 second slices), and it is seldom that all four users are crunching numbers at the same time.

A typical situation finds one user entering a program from the keyboard, one user listing his program, one user running his program, and one user staring at the CRT trying to figure out what he did wrong. I can see that eight users could degrade response time, especially if two or three users were crunching numbers. Table 1 shows exactly what to expect when two, three or four users do time-consuming jobs.

The argument that all users are down when a T/S system crashes is an important consideration and applies here. I can only respond to that after we have used our system for some time and see how reliable it is. Had we purchased several single-user micros, we probably would have had better graphics, but I am not convinced that I need graphics to teach the logic of programming.

I think response time will improve in T/S systems as the newer, faster chips come out and the CPU frequencies rise . . . and possibly as the 8-bit machine becomes rare. I can envision a 16-bit machine (if the people in the TI organization ever get one on the market) as fast in a T/S mode with eight users as a single-user 8080 machine now.

I believe there is a market for the T/S configuration. It may not be for the mass market or average consumer, at least not yet. I heard of a family (who owned an Altair, disk, etc.) that bought time-sharing. It was one way the father could get back on his machine without having to ask his children and wife to get lost. Who knows—in five years micros may come standard with the possibility of three or four simultaneous users.

We like our T/S system—we now have accessibility to the high-speed disk, we can print most programs in a matter of seconds, our Altair has been saved from obsolescence, and where else can you play Battleship, Star Trek, Hangman and monopoly simultaneously against an 8080 chip?■

Program:

```
10 FOR X = 1 TO 10000
20 NEXT
```

Time to run program in single-user BASIC: 14.5 seconds
Mits 8K Ver. 4.0

Time to run same program in Time-share system: Mits T/S Ver. 2.0

# of users running program	Time taken for each user to complete job	Average time to complete job once
1	16.6 sec.	
2	38.4 sec.	16.6 sec.
3	57.5 sec.	19.2 sec.
4	76.8 sec.	19.2 sec.

Table 1.

Reader Service—see page 179

TVBUG

Motorola has borne another in a long line of BUGS.

Tim Ahrens
7405 Ladybug St.
Austin TX 78744

Motorola has given birth to a new bug: TVBUG. From the very beginning, the easiest way to use the MC6800 series microprocessors and peripherals was through the different "BUGs," or developmental firmware provided from Motorola. These ranged from the original MIKBUG to MINIBUG II to MIKBUG 2.0 to the new TVBUG. This latest bug enables you to hook up to a standard color TV with a minimal number of parts.

Traditionally, Motorola's microcomponent division has not been overly active in the hobby market, mainly because of the difficulties in marketing small quantities. Since the MEK6800-D2 kit sold well in both the OEM and hobbyist market, other systems that the hobbyist can find useful are underway in Austin. One of these projects is TVBUG. The following pages describe how to build and use this system. This kit has great potential for both software generation and general games-type usage.

One of the main advantages of the TVBUG system is simplicity. One small printed circuit card can contain an entire microprocessor system with color-graphics display capabilities, 8K of user RAM, 6K of display RAM and a complete Kansas City (KC) Standard audio-cassette-tape interface. By connecting a standard ASCII keyboard and standard television set to the board, a complete system is born.

The system is composed of the following major pieces of hardware:

MC6808 MPU with clock
MC6847 Color Video Display Generator
MC6846P3 TVBUG with I/O and Timer
MC6821 Peripheral Interface Adapter
MC6850 Asynchronous Communication Interface Adapter
MC1372 Color RF (Radio Frequency) Video Modulator

Of course, external "glue" or hardware such as buffers and gates is required, but the above-mentioned parts represent the major portion of the chips.

This system can be wire-wrapped or built on a printed circuit board. Either is satisfactory and will provide a nice home-computer system. If you have been waiting for the easiest and least expensive hobby system, this is it!

Before describing how to hook it up, let's first go into TVBUG's insides to see how it works.

System Hardware

The TVBUG system as shown in Fig. 1 is configured for a minimum hardware application. This system includes the MC6808 Microprocessor, ROM with TVBUG 1.2, I/O, the MC6846 Timer, MC6821 PIA, MC6850 ACIA for serial I/O, the MC6847 Video Display Generator and an MC1372 Video RF Modulator. In addition to this, the schematic shows 1K byte of RAM for display, the stack RAM area and the user RAM. A KC Standard 300 baud cassette tape interface for ease of program storage is also shown.

Basic Operation

The new MC6808 (microprocessor with clock) is used as the microprocessor and is coupled with the MC6846P3 (ROM, I/O and timer) for a permanent monitor system. The MC6846P3 (TVBUG) has been programmed to "talk" to the MC6847 VDG display RAM as an output port, and a standard ASCII keyboard is connected to the MC6821 for data input. The actual hookup of the MPU is standard to almost any dedicated system with a few exceptions. The MCM2114s cannot have the $R/\overline{W}$ pulse applied to them during the normal MC680X cycle, as any data on the bus will be written to the RAM. To solve this problem, the combination of Ø2 with $R/\overline{W}$ will provide a delayed $R/\overline{W}$ pulse to be within the MCM2114 specifications.

All address decoding for 8K bytes of RAM has been done on board by use of the 74LS138 three-to-eight line decoder. With the decoding scheme shown, you can place up to 8K bytes of user RAM on the bus without further decoding, and decoding for every 1K block of memory from $D000 to $FFFF has also been provided. This latter decoding will provide you with an option of including up to an additional 5K bytes of display RAM to utilize the full 256 × 192 element graphic mode of the MC6847.

One note of caution though: No additional decoding (i.e., 74LS138s) can be supported by the higher-order address bus lines without using the traditional bus extenders. An alternative to this problem is to perform a different decode with the present 138s and use MCM-6641's (4K × 1)RAM chips. This would mean that additional RAM could be added, but only in 4K blocks. MCM2114s were used in this project because of their ability to be added in 1K block increments, thereby reducing the initial cost of the project.

The Break key on the board, through the use of cross-coupled NAND gates, provides an NMI (non-maskable interrupt) input with a debounced key closure. This switch will cause the current contents of the registers within the MPU to be displayed on the TV screen.

The RESET is a normally open switch that does not need to be debounced due to the RC time constant of the 3.3k Ohms and 100 uF capacitor and the Schmitt trigger input on the MC6808.

The MC6821 PIA is configured to receive key closures from a standard ASCII keyboard. The negative-going strobe must be at least 100 ms due to the type of polling used to scan for a keyboard input. Perhaps a more conventional way to poll the keyboard would have been through the use of the PIA's IRQ line; but by dedicating the IRQ vector to a keyboard input routine, the capability of using this line for a user function would have been lost.

Although the ACIA in this system is dedicated to a KC

Standard tape interface unit, you can switch the inputs and outputs to provide a different use for the serial I/O port.

In the transmit mode, the clock for the ACIA, and tone for the KC Standard, is provided by an MC1455. This 4800 Hz is fed into the transmit circuitry and, when combined with the TX (transmit) data, provides the traditional 2400 Hz for a Mark (1) and 1200 Hz for Space (0) required by the KC Standard. This output data is not the S1-S9 data format used by some other systems, but is a binary format that is compatible with the many Motorola MEK6800D2 kits now in use. The speaker audio is brought onto the board and fed into the input of an MC14584. This hex Schmitt trigger provides approximately 0.5 volts of hysteresis when operated at 5 volts, and it does an excellent job of squaring up the incoming audio tones.

Following this squaring of the tones, the data is processed and fed into the RX (receive) data pin of the ACIA. Connected to this is a leading edge detector which is used to reset the binary counter that feeds the RX clock signal. By doing the clock recovery in this manner, the binary counter is assured to be in synchronization with the data and to provide the proper clock pulse to the ACIA at the correct time.

The cassette interface provided in this documentation has proven to be an effective and reliable method for generating and recovering data from audio tapes, while using only six CMOS packages.

The VDG and Associated Circuitry

The MC6847 VDG operates like a microprocessor. It accesses its own RAM by putting out the specific addresses on the bus. Because of this, the VDG address bus must be separate from the MPU's address bus, but both must have the ability to address the common display RAM. By using the 8T97 Tri-state buffers on the address lines—wherever the "A" signal goes low, signifying that the MPU is talking to the display RAM—the VDG is turned off. In addition, the bidirectional databus buffers must have the same type of control. The other inverters and NAND gates (U19-A, B and U16-A, B, C) provide the display MCM2114s with the correct R/$\overline{W}$ signal. The VDG directly generates the chrominance and luminance analog (R-Y, B-Y, Y) output levels to be fed to the MC1372 rf modulator.

The new MC1372 modulator contains a chroma subcarrier oscillator (3.579 MHz to be used as a system clock) and all other circuitry necessary to support direct rf modulation to any standard color-television set. As shown in Fig. 1, the MC1372 clock is buffered and fed directly to the MC6847 and MC6808 EXTAL inputs where it is used as a system clock. This provides an internal system clock of approximately 895 kHz (Ø2).

The Tank L-C values shown (56 pF and .1 uH) will provide a center frequency of 67.25 MHz (channel 4). The component values required for channel 3 operation are 75 pF and .1 uH. This provides a center frequency of 63 MHz. The 75 Ohm output may be fed directly to the set or through a 75 to 300 Ohm matching transformer available wherever televisions or electronic components are sold. Either method *must* include a 60 db switch to minimize rf radiation problems (TVI). This assures that the antenna is disconnected while you use TVBUG.

Construction Hints

Several devices in Fig. 1 require adjustment; these include L1, R10, C4 and R6. The following is a tune-up procedure for these.

The value of L1 determines the frequency of operation—in other words, which channel you are on. This coil can be bought as a .1 uH tuneable coil or fabricated on almost any type of coil form that uses a ferrite slug for tuning. The prototypes were made on forms 1/8 inch in diameter with 3 1/2 turns of #30 gauge wire-wrap.

After you have placed the coil in the circuit, turn the television on to the desired channel (3 or 4) and turn the slug until a picture is presented on the screen. If confetti appears on the set, the coil could possibly be resonating at the wrong frequency. Change the channels until you see a clear picture. Turning the slug down into the coil lowers the frequency (and channel), and unscrewing it produces the opposite effect. If the picture is on an undesired channel, lower the frequency by adding one or two more turns.

The duty cycle adjustment varies the actual duty cycle of the 3.58 MHz clock. This is an optional part, since the MC1372 is internally set for a 50 percent duty cycle. Adjustment should be made while observing a picture and tuning the pot until you find the best picture.

Y1's frequency adjustment trimmer, C4, should be set for 3.57954 MHz with a frequency counter or adjusted until the television set responds with

Integrated Circuits: LSI, MSI, SSI

Qty	Part#	Function	Manufacturer	Designation
1	MC6847P	VDG	Motorola	U3
1	MC6808P	MPU		U1
1	MC6821P	PIA		U2
1	MC6846P3	TV BUG-RI/OT		U4
1	MC6850P	ACIA		U15
6	MCM2114	RAM		U9-U14
1	MC1372P	RF Modulator		U20
2	MC6887P	8T97		U5,U6
2	MC6889P	8T28		U7,U8
3	MC74LS138P	3 to 8 Decoder		U28,U29,U30
3	MC74LS00P	QUAD NAND		U17,U18,U19
1	MC74LS04P	Hex Inverter		U16
1	MC1455P	Oscillator		U27

Integrated Circuits: CMOS

Qty	Part#	Function	Manufacturer	Designation
2	MC14013BP	Dual D F-F	Motorola	U25,U26
1	MC14040BP	12 Bit Counter		U24
1	MC14584BP	Hex Schmitt Inv.		U22
1	MC14070BP	EXOR		U21
1	MC14001BP	NOR		U23

Resistors (1/4 W, ±5% composition):

Qty	Value: (Ω)	Designation
1	33k	R27
1	13k	R11
4	240	R1,R2,R3,R28
2	5.6k	R7,R14
1	75	R4
1	22k	R9
1	370	R15
1	750	R5
2	10k	R8,R13
1	2k	R19,R26
1	20k	R12
6	3.3k	R18,R21,R22, R20,R23,R24
1	1k	R17
1	100k	R16
1	510	R25

Adjustable Resistors (1 turn, carbon film, I10%)

Qty	Value: (Ω)	Designation
1	10k	R6
1	5k	R10

Capacitors (In microfarads, 25 WV dc ±10%, ceramic):

Qty	Value	Designation
12	0.01	C1,C2,C12,C13,C14,C15, C16,C17,C18,C19,C20,C25
2	100 (electrolytic) 16 V	C15,C21
1	50 pF	C5
5	0.1	C6,C8,C11,C22,C23
2	.001	C7,C24
1	.002	C14
1	2700 pF	C10
1	1500 pF	C13
1	56 pF	C3
1	.02	C9

Misc. Components

Qty	Component	Designation
1	Variable Capacitor 9 to 35 pF	C4
1	Crystal 3.57954 MHz	Y1
1	Transistor 2N2222	Q1
1	Keyboard-Cherry B70-05AB	
2	Switch Momentary B8600	S1,S2
1	Switch, DPDT, 60 dB separation @ rf	S3
1	Transformer, 75 to 300	T1
2	Diodes, IN 914	D1,D2

Parts list.

the correct colors.

The audio cassette standard has an adjustment, R10, which should be tuned for best data at pin 2 of the ACIA. This adjusts a time constant, and you will notice some chopping of the waveform until this adjustment has been made.

Care should be taken in parts placement, as there are several areas where there are low-level analog signals present. Fast digital signals do a good job of interfering with these, so keep as much space as possible between them. Also be sure to adequately bypass as shown in Fig. 1.

This minimum configuration provides a software and low-density (64 × 32 element) color-graphics development system. By expanding this system with a minimum number of components and enough support RAM (both display and user RAM), you can implement a full color-graphics system for any type of home computer, game or low-cost color-graphics system.

Firmware

The MC6846P3's ROM has been programmed with TVBUG—a system monitor that uses the MC6847 Video Display Generator as an output device into a standard color-TV set. The total package as shown in Fig. 1 provides you with a complete debug/operating system, input interface to a standard parallel ASCII keyboard and a KC Standard audio-cassette interface. The memory map of the TVBUG ROM and recommended RAM follows:

$FFFF
  TVBUG
  ROM
$F800
  6846
  I/O
$F3FF
  STACK
  AREA
  (2K FREE)
$F000
  FREE
$E400
  6K DISPLAY
  RAM
$CFFF
  USER RAM
  AREA 53K
$2000
  PROVIDED
  DECODING 8K
$0000

As you can see in the memory map, there is ample "free" space to execute even large user programs. Since the area from $E800 to $EFFF is also free, it can be used to put additional programs, such as disk operating system boots or standard graphics display packages, in EPROMs.

Operation of TVBUG

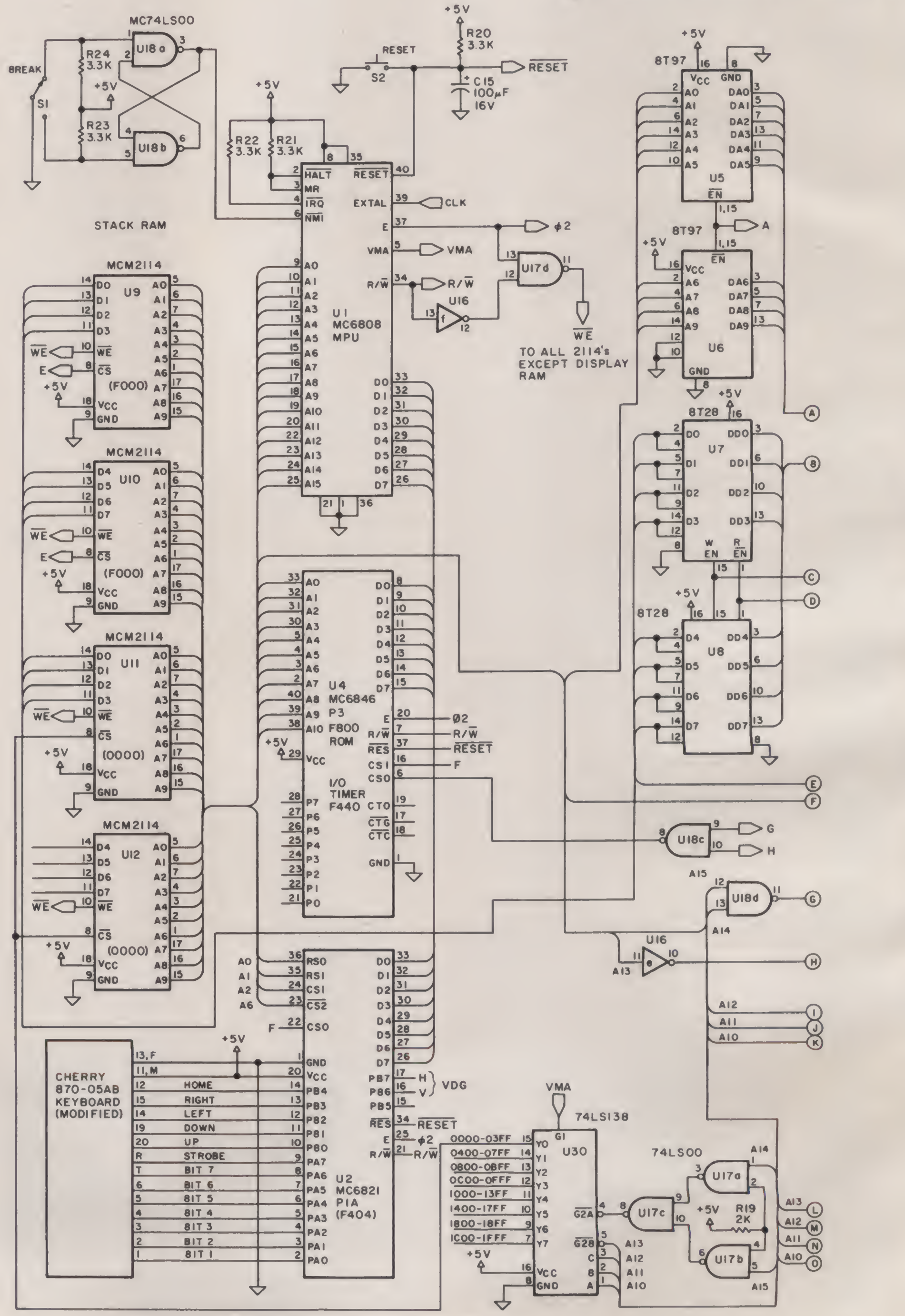
The following paragraphs delineate the use of, and some important features of, TVBUG.

Upon providing the system with 5 volts, the system executes a POWER-ON RESET, which initializes the entire system and prints the TV Bug-Debug system message at the top of the television screen. The cursor flashes through all of the eight available colors providing a blinking effect on the screen. The RESET button should be depressed anytime the program "blows away" or you wish to regain program control without displaying the internal CPU registers.

The Break key is really a debounced switch that is connected to the NMI pin on the MC6808. Depressing this key will display the current contents of the registers in the CPU:

CC	B	A	X	P	S
XX	XX	XX	XXXX	XXXX	XXXX

Fig. 1. MicroChroma 68 (TVBUG 1.2).



Where: CC is the condition code register
B is the B Accumulator
A is the A Accumulator
X is the Index Register
P is the Program Counter
S is the Stack Pointer.

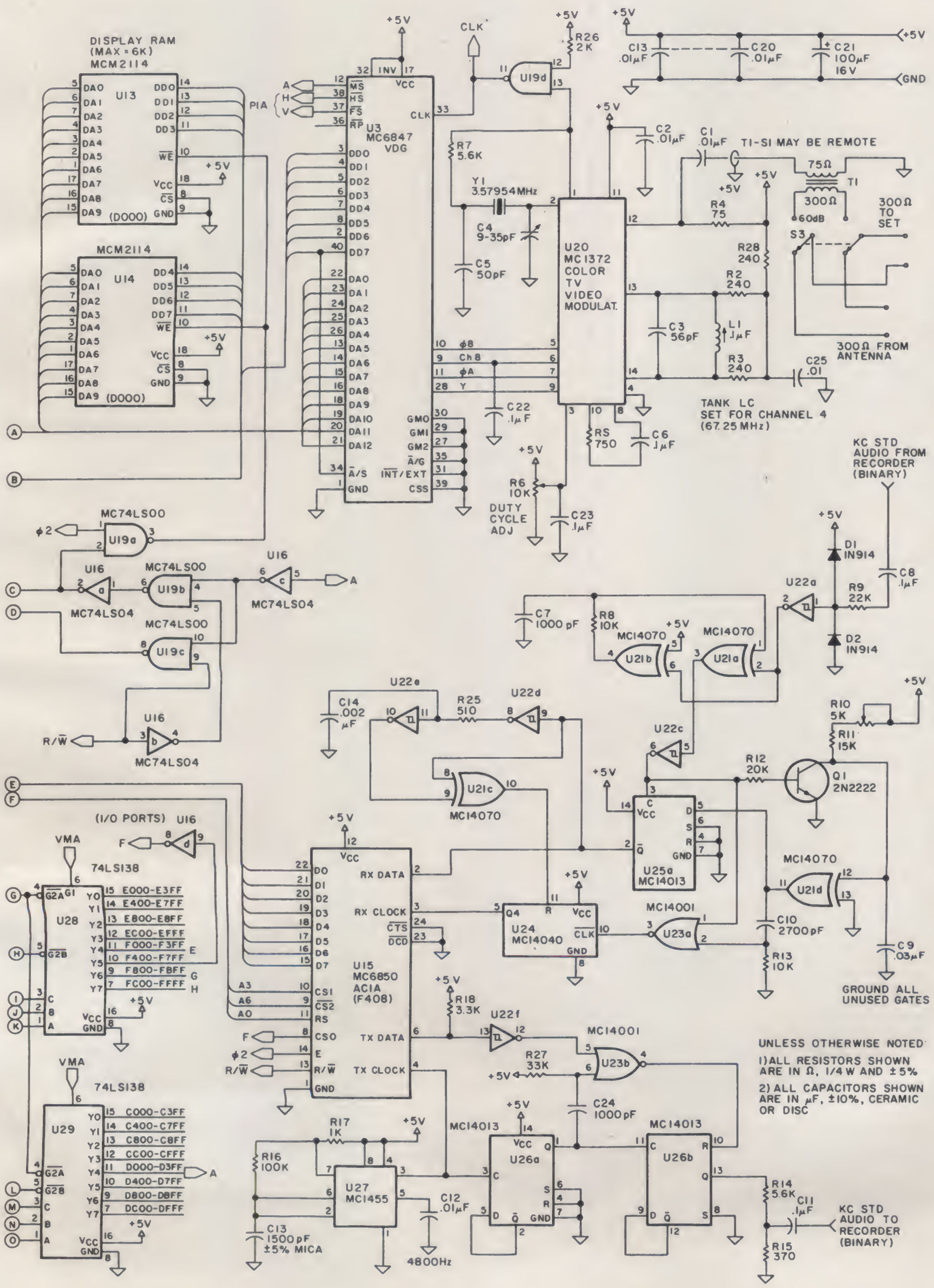
Following either a power-up condition, pressing the RESET switch or BREAK key, a TVBUG and blinking cursor will be displayed. TVBUG is ready for an input.

TVBUG Commands

The following is a list of commands. Each command is one letter followed by either an address or data. This information is always in hexadecimal form with leading zeros assumed. This means that only the last two or four digits will be used, depending on the command. The command is terminated by a non-hex entry (i.e., space bar) with the exception of the memory examine-change mode in which a line feed will increment the address by one, and ↑ will decrement the address by one.

Load Function—This function allows you to load a KC Standard binary-formatted audio-cassette tape. This includes tapes punched using Motorola's J-BUG monitor. To use this function:

1. Type L. TVBUG will ask for an offset.
2. Enter a 16-bit offset and type space. If no offset is required, type return.



3. Turn cassette recorder on.
4. Following recognition of data, the firmware will print the title of the tape, if any, and B for each 256 byte block. If the data is transferred to a location that either has no memory or a bad location, TVBUG will display the message "Memory Bad" and return to TVBUG program control.

Punch Function—This function allows you to store data from memory onto an audio cassette tape using the KC Standard. To use this function:

1. Type P. TVBUG will then ask for a beginning address.
2. Type the beginning address and a space. TVBUG will ask for the ending address.
3. Type the ending address. TVBUG will then ask for a name.
4. Type the name. It may be up to 32 characters long. If standardization with the Motorola MEK6800D2 kit must be maintained, do not include a B or G in the name, since these characters are interpreted by J-BUG as control characters.
5. Type return and turn on the recorder.

Verify Tape—This function is used to verify a punch or load operation. To use this function, you must perform a reset prior to use.

1. Type V. TVBUG will respond and ask for an offset. If desired, enter an 8- or 16-bit address.
2. Type a space and turn on the recorder.
3. TVBUG will print the incoming title and B for each 256 bytes of data checked against the memory. If the data on the tape and the memory do not agree, TVBUG will print "Memory Bad" and return to TVBUG Program Control.

Memory Change Function—This function will examine a location in memory, change contents if desired and return contents to memory. To use this function:

1. Type M.
2. Type the address to be changed and a line feed (leading zeros may be omitted).
3. TVBUG will print the address followed by the data in that location. If desired, enter the new

data. A line feed will return data to memory and open the next location. To return to TVBUG, press the return key.

Memory Examine Function—This function allows you to display a block of memory on the screen. To use this function:
1. Type E.
2. TVBUG will respond by asking for the beginning address.
3. Type the beginning address and a space, and TVBUG will respond by asking for an ending address.
4. Type the ending address and a space.
5. TVBUG will print the beginning address and contents of the first eight memory locations. Underneath the contents of each location is a period; if the data at that location is an ASCII character, it will replace the period. Each time a space is entered, the next eight locations will be printed until it reaches the ending address, at which time TVBUG will regain control.

Quick Load Function—This function allows you to enter blocks of hex data using the Memory Examine Function. To use this function:
1. Type Q. TVBUG will ask for a beginning address.
2. Type the beginning address and a space. TVBUG will ask for an ending address.
3. Type the ending address and a return. TVBUG will print the beginning address and wait for data.
4. Type the 8-bit hex data and follow with a space. The space will write the previously entered data into memory and open the next location. Following the eighth space, TVBUG will go to the next line and print the address of the ninth location and wait for data. When the ending address has been entered, TVBUG will regain program control.

Memory Fill Function—This function allows you to fill a blocked memory with any specified hexadecimal character. To use this function:
1. Type F. TVBUG will ask for a beginning address.
2. Type the beginning address and a space. TVBUG will ask for an ending address.
3. Type the ending address and a space. TVBUG will ask for a character.
4. Type the character and a space. TVBUG will write the character into each of the defined memory addresses, then return to TVBUG.

L—Load KC Tape
P—Punch KC Tape
V—Verify KC Tape with Existing Memory
M—Memory Change
E—Examine Block of Memory
Q—Quick Load of Hex Data
F—Fill Memory Block
O—Calculate Offset
R—Display Contents of Target Stack
Z—Clear Screen
S—Set a Breakpoint with Address "N"
U—Unset a Breakpoint with Address "N"
D—Delete all Breakpoints
B—Display all Breakpoints
N—Next Instructions
C—Continue Execution from Current Location
T—Trace "N" Instructions
!—User Defined Function #1
"—User Defined Function #2
#—User Defined Function #3

TVBUG commands.

Offset Calculation Function—This function allows you to calculate up to 16-bit offsets. Offsets outside two's complement limits will be printed followed by the message TOO FAR. This applies only to branch instructions. For calculations of KC tapes, add two to the resultant, which includes the beginning and ending address in a branch Instruction. To use this function:
1. Type O. TVBUG will ask for the beginning address.
2. Type the beginning address and a space. TVBUG will ask for the ending address.
3. Type the ending address and a return. TVBUG will print the offset and return to program control. Negative offsets will be printed as a 16-bit word. The least significant eight bits will be the offset.

Print Contents of Stack—This function allows you to examine the MPU registers by reading them from the stack. To use the function:
1. Type R.
2. TVBUG will place the contents of the MPU register onto the stack RAM and then place them on the screen.
3. The display will be:

```
CC B  A  X    P    S
XX XX XX XXXX XXXX XXXX
```

Clear Screen Function—To use this function:
1. Type Z.
2. TVBUG will clear the screen and return to the top left-hand corner with the TVBUG response.

Seven of the eighteen commands of TVBUG deal specifically with the uses of breakpoints. They are as follows:

Set a Breakpoint with an Address—To use this function:
1. Type S followed by the address and a return.
2. TVBUG will print the breakpoint address along with up to eight other breakpoints, then return to TVBUG. Breakpoints must be set in order, as the monitor will not rearrange them.

Unset a Breakpoint with an Address—To use this function:
1. Type U followed by the address.
2. Firmware will remove the breakpoint and return to TVBUG.

Remove All Breakpoints—To use this function:
1. Type D and return.
2. TVBUG will remove all breakpoints and return to TVBUG program control.

Print Out All Breakpoints—To use this function:
1. Type B.
2. Firmware will print out all breakpoints and return to TVBUG.

Next Instruction—This command allows you to single-step through a series of instructions. To use this function:
1. Type N.
2. TVBUG will execute the next instruction and print the contents of the stack.

Continue—The Continue command is used to stop the program from breakpoint to breakpoint. To use this function:
1. Type C.
2. Firmware will execute program from current location to the next breakpoint and print out contents of stack.

Trace "N" Instructions—This command works exactly like Next Instruction, except after entering T:
1. Enter the number of instructions to be traced and a return.
2. TVBUG will print out the contents of the target stack after each instruction, then return to program control.

User Function !, " and #—These functions are used for one key call-up of specific routines. To use these functions:

1. For user number one function, enter the starting locations, first high then low byte, of the routine into memory locations $F397 and $F398.
2. For number two function, use locations $F39A and $F39B.
3. For number three function, use locations $F39D and $F39E.

By doing this, the call-up of specific programs can be accomplished by merely pressing one key.

Some Other Functions of Interest

SWI, IRQ, NMI—The same way the user 1, 2 and 3 functions are utilized, the SWI, IRQ and NMI vectors can be utilized. By supplying addresses in the following locations, programs can be executed by vectoring to any of the interrupt pointers:
1. IRQ—$F37A, $F37B
2. SWI—$F384, $F385
3. NMI—$F380, $F381

Note: All of the user functions must be loaded with the appropriate data following RESET. A *RESET* condition will re-

initialize this area in the stack.

User Functions Input and Output—The purpose of these functions will allow additional input and output ports attached to a TVBUG system for a hard copy or additional CRTs.

Input Routine. Each time the input routine goes around in a loop looking for an input from the keyboard, a subroutine located at locations $F390, $F391 and $F392 is called. Since these all contain 39s (return from subroutines), the program will jump back out and continue looking for a keyboard input.

Suppose you have an external RS-232 device that is to be connected as an input. After performing the necessary hardware additions, you must change the software to allow this to happen. Placing 7E, XX,XX (where XX,XX is the location of the input subroutine) into locations $F390, $F391 and $F392, respectively, allows the input loop to look at the alternate input routine.

There are several constraints in using this. Be sure to load the subroutine program before loading in the jump vectors, since the keyboard routine will go to this location. If nothing is there, the whole program will be destroyed. Place the vectors and JSR in the order $F392, $F391, $F390, because after the 39 in location 90 is replaced with a 7E, the program will automatically start executing. Be sure to end your subroutine with an RTS (39) and don't trap the routine; otherwise you can't use the keyboard until you have had an input from the peripheral and it falls back through the loop. By the way, put the input character in the A accumulator. For further understanding of the routine, look at the flowchart in Fig. 2.

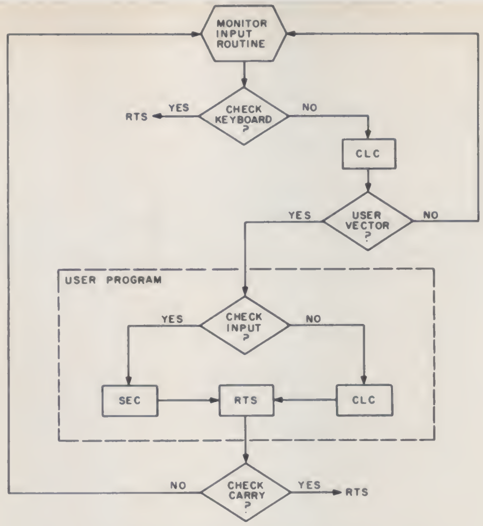


Fig. 2. Flowchart for User Input Function.

Output Routine. The user routine is convenient for interfacing a hard-copy printer or extra peripheral. The jump vectors work the same and should be handled accordingly. These reside at $F393, $F394 and $F395, where $F393 is the instruction (7E) and $F394 and $F395 are the high and low byte, respectively, of the subroutine address. Once again, end the routine with an RTS, and if interfacing to a printer, be sure to put in enough nulls for a CR, as TVBUG will output no nulls. See Fig. 3 for the flowchart.

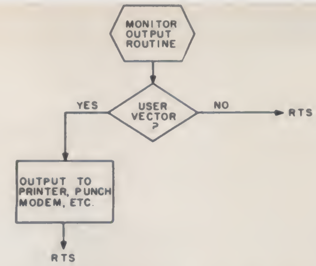


Fig. 3. Flowchart for User Output Function.

Conclusion

Well, there you have it. Up until now, to own a computer you had to have lots of money, a Teletype/terminal or another TV set in the house to use as a monitor. This kit guarantees to have no blinking lights, multitudes of switches or any complicated methods of usage. A single 5 volt supply and your TV set is all you need. Maybe this should be part of the TVBUG challenge! Can you pull your family away from the tube to play with TVBUG? Of course, TVBUG works fine with that extra black and white set, but the colors are weak! Plug it in, turn it on and watch TVBUG come alive in color before your eyes.

It's easy to build, whether wire-wrapped or with the printed circuit board. The kit is called MicroChroma 68 or SCPROMO2 and is available from any Motorola distributor. Oh, by the way, the price for the board and LSI devices is around $129.

Other applications of TVBUG include bus expansion, printer drivers, adaptation of common BASICs for TVBUG (SWTP, Tiny BASIC, Mits, Microsoft), easy expansion of TVBUG and even a version of a Morse code receiver/transmitter terminal for ham operators. How many more can you think of? ■

✓ Reader Service—see page 179

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Creative Tabulation

This programming technique allows you to create right-justified columns (certainly a convenient feature to have) and also gives your computer the capabilities of a larger system.

The utility of BASIC as a programming language these days is beyond question. Many programs being written involve money or other similar columned data. Unfortunately, most BASICs have only a TAB command to format columns of figures. This results in columns with the left margin justified and the right margin ragged (see Fig. 1a). A PRINT USING command, found in some interpreters, can be used to put the numbers where you want them and even to append dollar signs, but this is not available in most small-system BASICs.

By a creative use of the TAB command, coupled with the

```
0010 REM *************************
0020 REM *        PROGRAM  1       *
0030 REM * CREATIVE  TABULATION *
0040 REM *                        *
0050 REM * MARC I. LEAVEY, M.D. *
0060 REM *************************
0070 DIGITS= 2:LINE=0
0100 PRINT TAB(5);"A";TAB(25);"B";TAB(45);"C";TAB(65);"D"
0110 PRINT
0120 READ N
0130 IF N=0 GOTO 9999
0140 REM
0150 REM FIRST PRINT IT PLAIN
0160 REM
0170 PRINT TAB(2);N;
0180 REM
0190 REM NOW RIGHT JUSTIFY
0200 REM
0210 PRINT TAB(30-LEN(STR$(N)));N;
0220 REM
0230 REM ADD A COLUMNED DOLLAR
0240 REM
0250 PRINT TAB(40);"$";
0260 PRINT TAB(50-LEN(STR$(N)));N;
0270 REM
0280 REM OR A TIGHT ONE...
0290 REM
0300 PRINT TAB(70-LEN(STR$(N)));"$";N
0310 GOTO 120
0320 REM
0330 REM DATA STATEMENTS WITH
0340 REM THE NUMBERS TO PRINT
0350 REM
0360 DATA 10,12.3,2,.8,200.54,56.1
0370 DATA 5,32.5673,99.3,0
0400 REM
9999 END
```

Program 1.

```
0010 REM *************************
0020 REM * PROGRAM 2 -- MAKE AN *
0030 REM * ACCOUNTING TYPE LIST *
0040 REM *                       *
0050 REM * MARC I. LEAVEY, M.D. *
0060 REM *************************
0070 DIGITS= 2:LINE=0
0080 PRINT TAB(10);"LIST"
0090 PRINT TAB(10);"----";PRINT
0100 READ N
0110 IF N=0 GOTO 999
0120 PRINT TAB(7);"$";
0140 LET N1=ABS(N)
0150 PRINT TAB(14-LEN(STR$(N1)));N1;
0160 IF N<0 THEN PRINT "-";
0170 PRINT
0180 GOTO 100
0200 DATA 1,22,43.5,-55.1,899.77,-.99,23.4,-33,-.1,0
0999 END
```

Program 2.

```
READY
#RUN
    A                   B                   C                   D

 10.00               10.00        $        10.00             $10.00
 12.30               12.30        $        12.30             $12.30
 2.00                 2.00        $         2.00              $2.00
 0.80                 0.80        $         0.80              $0.80
 200.54             200.54        $       200.54            $200.54
 56.10               56.10        $        56.10             $56.10
 5.00                 5.00        $         5.00              $5.00
 32.56               32.56        $        32.56             $32.56
 99.30               99.30        $        99.30             $99.30

READY
#
```

Fig. 1.

```
READY
#RUN
         LIST
         ----

      $   1.00
      $  22.00
      $  43.50
      $  55.10 -
      $899.77
      $   0.99 -
      $  23.40
      $  33.00 -
      $   0.10 -

READY
```

Program 2 sample run.

```
0010 REM *************************
0020 REM * PROGRAM 3 - SIMULATE *
0030 REM * THE "DIGITS" COMMAND *
0040 REM *     OF SWTPC BASIC    *
0050 REM *                       *
0060 REM * MARC I. LEAVEY, M.D. *
0070 REM *************************
0100 INPUT "NUMBER, PLEASE",A
0110 LET A1=-(INT(A)-A)
0120 LET A$=STR$(A1)
0130 IF A1<.01 THEN A$="0.00"
0140 IF LEN(A$)=4 GOTO 170
0150 IF LEN(A$)>4 THEN A$=LEFT$(A$,4)
0160 IF LEN(A$)<4 THEN A$=A$+"0"
0170 LET A$=RIGHT$(A$,3)
0180 LET A$=STR$(INT(A))+A$
0190 PRINT "DIGITIZED VERSION = ";A$
0200 GOTO 100
0999 END
```

Program 3.

```
READY
#RUN
NUMBER, PLEASE? 1
DIGITIZED VERSION = 1.00
NUMBER, PLEASE? 2.3
DIGITIZED VERSION = 2.30
NUMBER, PLEASE? .34
DIGITIZED VERSION = 0.34
NUMBER, PLEASE? .01
DIGITIZED VERSION = 0.01
NUMBER, PLEASE? 678.992
DIGITIZED VERSION = 678.99
NUMBER, PLEASE? 10.228
DIGITIZED VERSION = 10.22
NUMBER, PLEASE? .005
DIGITIZED VERSION = 0.00
NUMBER, PLEASE?
READY
#
```

Program 3 sample run.

ability to determine the length of a string, a standard, right-justified display is easy. One condition is the use of the DIGITS command, as found in SWTP BASIC, to truncate or fill the right of the decimal point to two places. I'll show a way to get around that later, but for now, bear with me.

How TAB Works

The TAB command operates by referencing the column to a set left margin, the argument of the TAB command. Thus if you say, "TAB(20)," the first character to be printed is at the 20th print position. What we will do is reference the *last* position, having ensured that all data has two decimal places, and subtract back to find where to start.

Fig. 1b shows the result of this technique. See how nice the columns look! By a little more manipulation, nicely columned dollar signs can be added, as in Fig. 1c, or "tight" dollar signs (Fig. 1d). A little more manipulation can produce trailing minus signs, as used in accounting (see Program 2 sample run).

Program 1 produced all of the columns in Fig. 1. The REM statements tell you which is which. Similarly, the accounting form in the Program 2 sample run was produced by Program 2.

The DIGITS Command

I did promise to show you how to fake the DIGITS command: Follow Program 3 for the steps. We first will extract the fractional part of the number by negating the subtraction of the integer from the number. This is converted into a string, and a series of string manipulations truncate or fill to two decimal places.

The product of these manipulations is concatenated to the original integer and converted to a string; the result is printed. To merge these two programs, substitute the "A$" here for the "STR$(N)" in the previous programs and perform the manipulations prior to tabbing.

This is a rather nice technique to apply to programs that produce data for others to use, and it gives your computer the capabilities of much larger systems. ■

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A Handle on Programming

Allan has several handles on programming. This one grasps arrays and gamesmanship.

Although the TRS-80 Level II book is complete (factually speaking), it is not exactly the same gold mine of exposition that the Level I book is. Certain things are left to your intuition, and if you are like me, that spells problems with programming. The simple "game" in the program listing is offered as a programming playground to examine some of the puzzlements that may have allowed you to snatch programming defeat from the jaws of victory.

The "game" asks you to input a guess of a boy's name. If the name selected is contained within the memory bank of the program, you are awarded a correct guess; if not, you are awarded an incorrect guess. Scoring keeps track of right and wrong guesses and prints the running results on the screen. Scoring also limits the total number of tries to 10, after which your final score of right and wrong answers is flashed on the screen. Sure, it is not Star Trek or Wumpus, but it has been effective in grabbing the attention of the young visitors to my house. It is one answer to "What can your computer do?"

The main interest here is just how some of the routines work and how to implement them into a program without the annoyance of getting rid of a series of error messages during the programming process. One of the nice things about a computer program is that it is not a gigantic monolith. The biggest program is merely the sum of many small steps and routines. What this really means is that either you commit many of the "standard" routines to memory or, better still, inscribe them in what I choose to call a stylebook.

The Program

From the simple game description, it is obvious that a part of this program has to create a memory bank of boys' names. Then you have to program a way to input your guess. When this is done, the program must provide for a mechanism to search its memory for a match or lack of match of the input guess. Then it has to indicate the condition it found and implement the scoring.

We can create the memory bank by using an array, but since we are dealing with names to be stored and not numbers, we must amplify that to the use of a string array. Refer to the program listing . . . you will find that lines 1 through 22 are used for the creation of the memory bank. You can check this out by temporarily inserting a line 25 END.

If you then input Print A$(4) (in the calculator mode), for example, it would print out the fourth data item, namely Ted. Notice that A$ has been dimensioned at 20. The data lines carry a total of 18 items, so that A$ has to be dimensioned at least as high as 18 but can be set a bit higher to allow for some expansion of the data file.

If the maximum value for J in line 7 is set less than the total data items, you will have an incomplete data set in the data file. If it is set higher than the total data items, then your program will deliver an OD error message, indicating that an out of data condition has been programmed.

Line 100 provides the screen message and allows the name guess to be input. The next four lines (310 to 380) provide the search through the data file. You should notice that in line 325 if the maximum value assigned to I does not equal the data element total, then the entire array will not be searched, resulting in lost data. If I is made larger than the total number of data elements, then the search will merely be running through blank spaces, which is a waste of motion.

Notice the position of the DIM statement in the program. It is not included accidentally in any of the loops. The good book usually says, "Put the DIM statement early in the program," but if you don't put it in properly, you will get the delightful DD error message, with the resultant hunt for the DEBUG.

The Restore statement is needed because in a program of this type you can't throw away entries in the array. Without the restore statement, you would be served up another OD error message with resultant problems.

There is an interesting way of losing a piece of data when typing in the data lines. Suppose in line 20 you accidentally or unwittingly typed a comma after the last name on the line. The computer would interpret this as, "There is a piece of data after Wayne, but since the operator didn't type in any letters I will fill that array cell with nothing." And that is exactly what it would do. You would wind up with one more piece of data in the data file than you

```
  1  DIM A$(20)
  2  CLS
  5  RESTORE
  7  FOR J = 1 TO 18
 10  READ A$(J)
 15  NEXT J
 20  DATA TOM, JERRY, BILL, TED, FRANK, JACK, ARNOLD, DAN, WAYNE
 22  DATA HARRY, CARL, TED, JIM, MARK, RAYMOND, CLARK, PHILLIP, IRA
100  INPUT "GUESS A BOY'S NAME "; B$
310  I = 0
320  I = I + 1
325  IF I>18 PRINT "NAME NOT ON LIST" : GOTO 420
380  IF A$(I) = B$ GOTO 410
390  GOTO 320
410  PRINT "NAME IS ON THE LIST"
415  N = N + 1: PRINT @ 198, "CORRECT GUESS #" N: GOTO 438
420  D = D + 1
430  PRINT @ 326, "WRONG GUESS #" D
438  PRINT @ 837, "TOTAL GUESSES" N + D
439  IF N + D = 10 PRINT " YOUR GUESS IS " N "RIGHT" D "WRONG": END
440  FOR T = 1 TO 1000: NEXT T
450  GOTO 2
```

Program listing.

thought you had. In this program the search is through 18 array cells and you have filled 19 array cells, which means that the last name shown in the data file (in this case, Ira) could not be reached.

You know that you put this name in the data file, yet if you input this name the program would count you as having made an incorrect guess. This is a charming little item that you do not want to leave to your intuition. As the man says, "It's fun to be fooled, but it's more fun to know," and that goes triple when you are programming a computer.

The scoring portion of the program should be easy to follow. The general scheme comes in handy in any program that has to keep score on the screen. Lines 415, 430 and 438 show one good method of making everything come out properly on the screen. Just pay close attention to the use of the quote signs and everthing will fall into place. Line 440 is merely a timing loop to hold the scoring information and titling information on the screen long enough for you to visually digest.

You may be wondering why line 310 I=0 is needed. This line, in conjunction with I=I+1, is part of the search mechanism. If I were not set back to 0 after each guess, the value of the counter I would continue to be incremented from the value it had assumed from the last pass through the program. You can demonstrate this for yourself by deleting line 310 and adding a temporary line 322 PRINT I. Then run two consecutive guesses through the program, and the screen printout will make very clear that you need line 310 to initialize the value of the counter.

You have undoubtedly come across the phrase "BASIC is an easy language," and the statement is probably true compared to, say, APL. But I prefer the original quote from Murphy himself, who said, "Where programmers work, there I lurk!" And you had just better believe he was basically on the level! ■

Keepbook

This NS BASIC bookkeeping program is manageable—and adaptable to other BASICs.

Robert L. Marx
1077 Ticonderoga Dr.
Sunnyvale CA 94087

Everyone knows by now that the home computer is ideal for simple bookkeeping systems. Every catalog tells us that we can easily program our computers to keep track of household expenses, or even use its capabilities for our small-business needs. Somehow, in over three years as a computer owner, however, I had never gotten around to this application, even though I run a small business from my home and went through the monthly drudgery of "doing the books" with pencil, paper and a pocket calculator.

All that is changed now. After checking out several commercially available accounting packages, I discovered that all of them were too expensive or tailored to the needs of a professional accountant rather than to my needs, or both. So finally I wrote my own system, which I call Keepbook. It meets my needs, and I use it every month not only for my business, but also to keep track of normal household expenses.

ITEM	AMOUNT	ACCT	DESCRIPTION	DATE	REMARKS
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					
11					
12					
13					
14					
15					
16					
17					
18					
19					
20					
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48					
49					
50					

Fig. 1. Entry source document.

System Requirements

In building Keepbook, I first had to decide just what my needs were. This took a few weeks of thinking about and studying the problem. I decided that the following factors were most important.

First, the system had to be simple. I only use the program once a month, so I don't want to have to review a complicated set of rules and procedures every time. This requirement resulted in a HELP command within the program, extensive editing of all input data and clear diagnostic messages when a mistake is encountered.

Second, I decided that the system should be simple in concept. My accounting problems are not involved with return on investment or other sophisticated accounting principles. I just want to know if there is more money coming in than going out, how much more, and where the money is going.

This requirement led to a design that allows me to set up accounts and to post expenses and income to those accounts and have the computer keep track of current balances and year-to-date balances for each account. Of course, I wanted a general picture of how I am doing, so the program had to provide sums for total expenses and total income and the difference between them, both on a current basis and on a year-to-date basis.

Third, I wanted the system to be reasonably foolproof. In particular, I wanted some backup capability in case my floppy diskette got scratched, or the power failed while I was updat-

```
                    Summary Report for March 1979
      Account Number and Name                          Current $ Year-to-date

       1 Food expenses                                  $401.55 $1,233.67
       2 Clothing expenses                               $81.00   $473.50
       3 Rent and house upkeep expenses                 $201.44   $912.44
       4 Transportation expenses                         $88.50   $276.85
       5 Recreation expenses                               $.00   $135.67
       6 Entertainment expenses                          $11.75    $97.80
       7 Utilities expenses                              $40.96   $127.23
       8 Home furnishings expenses                         $.00    $77.99
       9 Medical & Dental expenses                       $33.50    $75.50
      10 Insurance premiums                              $79.00   $238.50
      11 Savings                                           $.00    $42.50
      12 Employment income                            $1,500.00 $4,500.00
      13 Dividend/interest income                        $23.60    $68.38
      14 Other income                                   $125.00   $125.00
         GROSS INCOME                                 $1,648.60 $4,693.38
         TOTAL EXPENSES                                 $937.70 $3,691.65
         NET INCOME                                     $710.90 $1,001.73
      Current expenses from line items  22 to  32
```

Fig. 2. Financial summary output.

ing the files.

This resulted in the choice of writing to disk files after every transaction, rather than holding data in RAM until the end of a data-entry session. It also convinced me to use a paper source document for data entry, so that in the worst of all possible cases I could at least recreate the files from paper. (It also allowed me to simplify the computer files and provide readable documentation for auditors, if necessary.)

Finally, I wanted the system to be flexible enough to serve several purposes. I wanted to have one set of files for my primary business, another for my home accounts and perhaps still others to track specific investments that I wanted to isolate for maximum financial visibility.

Output

The requirements analysis led directly to the only two outputs produced by Keepbook: the entry source document and the financial summary report.

The entry source document is shown in Fig. 1. It consists of individual line items pre-numbered by the computer. A line item is either an expense item or an income item (determined by the account number, which is described later).

For each line item, the user fills in the amount, the account number, a description of the item, the date and remarks (which I use to record check numbers). Each numbered line item is filled in, mixing expense and income items in any order. As we shall see later, only the amount and the account number are entered into the computer, keeping the boring task of keying data to a minimum.

The financial summary output is shown in Fig. 2. For each account, the account number, account title, current balance and year-to-date balance are shown. At the end of the output, a total for expenses, total for incomes and net income are presented.

The line items used to make up the current balances are also shown, directly tying the summary back to the paper source document. The source document, as we have already seen, provides a direct tieback to individual receipts, check stubs, etc., so the whole package hangs together.

Options

The program provides eight separate routines, which are displayed on the screen in a menu, as can be seen from the first block of instructions of the program listing, called the initialization block. The routines, or options, are:

1. Construct a new file
2. Start a new year
3. Start a new month
4. Add data
5. Print monthly summary
6. Help
7. Print source document
8. Quit the program

The user selects an option from this menu, and program control shifts to the appropriate routine. At the completion of the option, control returns to the initialization block of the program, and the menu is again presented.

Construct a new file. Option 1 sets up a new file. Before running this option the user should spend some time thinking about the output he/she wants. He/she is permitted to specify as many different accounts as desired. Accounts are numbered by the computer in the order entered and are printed in that order, so some forethought will result in a more attractive printout.

Each account is referred to by number and also by the user-specified name, which may be up to 40 characters long. Each account must also be specified by the user as an expense (E) or income (I) account, which is used by the program in the totaling calculations. All this is coached on the screen during input.

Although the user never has to worry about it, the file structure created during this option is interesting to study. Each account record is 62 bytes long, which includes the account ti-

Program listing.

```
100 REM SIMPLE BOOK KEEPER
200 REM INITIALIZATION
300 LINE#1,132¢B9$=CHR$(26)¢REM BLANK SCREEN
400 DIM T$(40),F$(8),O$(1),T2$(50),L9$(62),L8$(62)
500 D0=0¢D1=1¢REM DEVICE NRS
600 PRINT#D0,"Options are:"
700 PRINT#D0,"1=Contruct new file"
800 PRINT#D0,"2=Start new year          3=Start new month"
900 PRINT#D0,"4=Add expense entries     5=Print monthly summary"
1000 PRINT#D0,"6=H E L P                 7=Print source sheet"
1100 PRINT#D0,"8=Quit"
1200 INPUT#D0,"OPTION = ",O
1300 IF O=INT(O) THEN 1400¢PRINT"ERROR:MUST BE INTEGER"¢GOTO 600
1400 IF O>0 AND O<9 THEN 1500¢PRINT#D0,"ERROR"¢GOTO 600
1500 ON O GOTO 1700,4000,5000,5700,7200,9900,11800,11500
1600 REM ****************
1700 REM OPTION = CONSTRUCT FILE
1800 INPUT#D0,"How many accounts are there ",A1¢A1=INT(A1)
1900 IF A1>0 THEN 2000¢PRINT"Minimum 1"¢GOTO 1800
2000 INPUT#D0,"Name of your data file ",F$
2100 CREATE F$,(A1+1)*62/256+1¢REM SIZE FOR (A1+1) RECORDS,EACH 62 BYTES
2200 OPEN#0,F$
2300 FOR I=1 TO A1
2400 PRINT#D0,"Title for acct. nr. ",I¢INPUT#D0,T$
2500 INPUT#D0,"Is this an expense(E) or income(I) acct.",O$
2600 IF O$="I" THEN S1=1 ELSE IF O$="E" THEN S1=-1 ELSE 2500
2700 WRITE#0%62*I,T$
2800 WRITE#0%62*I+42,I
2900 WRITE#0%62*I+47,S1
3000 WRITE#0%62*I+52,0
3100 WRITE#0%62*I+57,0
3200 NEXT
3300 WRITE#0%0,A1,1,1
```

```
3400 REM FILE STRUCTURE¢NR ACCTS,HIGHEST ENTRY LINE,LOWEST E.L.
3500 REM TITLE/ACCTNR/EXPTYPE/CURRENT$/YTD$
3600 INPUT#D0,"File is built. Hit 'return' to continue",O$
3700 CLOSE#0
3800 PRINT#D0,B9$¢GOTO 600
3900 REM ****************
4000 REM OPTION=START NEW YEAR
4100 GOSUB 13300
4200 FOR I=1 TO A1¢WRITE#0%62*I+52,0,0,NOENDMARK¢NEXT
4300 WRITE#0%5,1,1
4400 PRINT#D0,"File is set for new year"
4500 PRINT#D0,"Be sure to start a new sequence of line items at one."
4600 CLOSE#0
4700 PRINT#D0,"File set for new year"
4800 INPUT#D0,"HIT 'RETURN'",O$¢PRINT#D0,B9$¢GOTO 600
4900 REM ****************
5000 REM OPTION = NEW MONTH
5100 GOSUB 13300
5200 FOR I=1 TO A1¢WRITE#0%62*I+52,0,NOENDMARK¢NEXT
5300 WRITE#0%10,L1,NOENDMARK
5400 PRINT#D0,"File set for new month"¢CLOSE#0
5500 INPUT#D0,"HIT 'RETURN'",O$¢PRINT#D0,B9$¢GOTO 600
5600 REM ****************
5700 REM OPTION = ADD ENTRIES
5800 GOSUB 13300
5900 PRINT#D0,"Enter amount 0,account 0 to quit"
6000 PRINT#D0,"line ",L1," Amount$",¢INPUT1#D0,A¢INPUT#D0," AcctNr",A2
6100 IF A2>0 THEN 6400
6200 PRINT#D0,"Data entry completed"
6300 INPUT#D0,"hit 'return',O$:PRINT#D0,B9$:CLOSE#0:GOTO 700
6400 IF A2=INT(A2) THEN 6500¢PRINT"ERROR"¢GOTO 6000
6500 IF A2>0 AND A2<A1+1 THEN 6700
6600 PRINT"Accounts in range 1 - ",A1¢GOTO 6000
6700 READ#0%A2*62+47,S1,C1,Y1
6800 A=A*S1¢C1=C1+A¢Y1=Y1+A¢WRITE#0%A2*62+52,C1,Y1,NOENDMARK
6900 L1=L1+1¢WRITE#0%5,L1,NOENDMARK
7000 GOTO 6000
7100 REM ****************
7200 REM OPTION=PRINT SUMMARY
7300 GOSUB 13300¢I1=0¢I2=0¢E1=0¢E2=0
7400 INPUT#D0,"Month and year for title ",T2$
7500 INPUT#D0,"Printer on, paper in, hit 'return'",O$¢PRINT#D0,B9$
7600 PRINT#D1
7700 PRINT#D1,TAB(15),"Summary Report for ",T2$
7800 PRINT#D1,"Account Number and Name",TAB(50),"Current $",
7900 PRINT#D1,TAB(60),"Year-to-date"¢PRINT#D1
8000 FOR I=1 TO A1
8100 READ#0%62*I,T$¢READ#0%62*I+47,S1,C1,Y1
8200 IF S1=1 THEN 8300¢E1=E1+C1¢E2=E2+Y1¢GOTO 8400
8300 I1=I1+C1¢I2=I2+Y1
8400 PRINT#D1,%4I,I,
8500 PRINT#D1,TAB(5),T$,
8600 PRINT#D1,TAB(50),%C$10F2,ABS(C1),ABS(Y1)
8700 NEXT
8800 PRINT#D1,TAB(5),"GROSS INCOME",TAB(50),
8900 PRINT#D1,%C$10F2,ABS(I1),ABS(I2)
9000 PRINT#D1,TAB(5),"TOTAL EXPENSES",TAB(50),
9100 PRINT#D1,%C$10F2,ABS(E1),ABS(E2)
9200 PRINT#D1,TAB(5),"NET INCOME",TAB(50),
9300 PRINT#D1,%C$10F2,I1+E1,I2+E2
9400 IF L1<=L0 THEN 9600
9500 PRINT#D1,"Current expenses from line items ",L0," to ",L1-1
9600 INPUT#D0,"Please turn off printer and hit 'return'",O$
9700 PRINT#D0,B9$¢CLOSE#0¢GOTO 600
9800 REM ****************
9900 REM OPTION = HELP
10000 PRINT#D0,"Bookkeep is a simple bookkeeping system"
10100 PRINT#D0,"based on the idea that you have line item"
10200 PRINT#D0,"expenses and incomes which fit into account"
10300 PRINT#D0,"categories. Current period (month) and year-"
10400 PRINT#D0,"to-date totals are maintained. When you construct"
10500 PRINT#D0,"a new file all accumulators are set to zero, as"
10600 PRINT#D0,"they are with the new-year option, whereas"
10700 PRINT#D0,"the new-month option only sets the current"
10800 PRINT#D0,"accumulators to zero. To assure that you are"
10900 PRINT#D0,"recording all expenses, the system coaches"
11000 PRINT#D0,"for line items, so use the option to print"
11100 PRINT#D0,"data collection sheets as needed."
11200 INPUT#D0,"Hit 'return' to continue",O$¢PRINT#D0,B9$
11300 GOTO 600
11400 REM ****************
11500 REM OPTION = END
11600 PRINT#D0,B9$¢PRINT#D0,"GOODBYE"¢END
11700 REM ****************
11800 REM OPTION=PRINT SOURCE SHEET
11900 INPUT#D0,"Lowest sequence number desired ",L0
12000 L0=INT(L0)¢IF L0>0 THEN 12200
12100 PRINT#D0,"Lowest number allowed is one"¢GOTO 11900
12200 INPUT#D0,"Printer on, paper in, hit 'return'",O$
12300 PRINT #D1," ITEM  AMOUNT  ACCT  DESCRIPTION
12400 PRINT #D1,"        DATE   REMARKS"
12500 L9$=""¢FOR I=1 TO 30¢L9$=L9$+CHR$(95)¢NEXT
12600 L8$=L9$(1,1)+"|"+L9$(1,8)+"|"+L9$(1,4)+"|"
12700 L8$=L8$+L9$(1,30)+"|"+L9$(1,6)+"|"+L9$(1,10)
12800 FOR I=L0 TO L0+49
12900 PRINT#D1,%4I,I,L8$
13000 NEXT
13100INPUT#D0"Turn printer off and hit 'return'",O$¢PRINT#D0,B9$¢GOTO600
13200 REM ****************
13300 REM OPEN FILE ETC
13400 INPUT#D0,"Name of your data file ",F$
13500 OPEN#D0,F$
13600 READ#0%0,A1,L1,L0
13700 RETURN
```

tle (40 characters plus two bytes of overhead), five characters for a real-number representation of the current balance and a final five bytes for the year-to-date balance.

The account number is represented by the position in the file (i.e., the ith account is stored starting at 62 times i bytes into the file). Since the lowest account number is one, this leaves the first 62 bytes of the file available, and some of this room is used to store three real numbers, representing the number of account numbers specified by the user, the next line item number to be coached for data entry and the lowest line item number used in the current balance period.

Notice that the program is written in North Star BASIC, release 4, and uses the capabilities of that language to read and write to this file structure as a random file. It also uses the CREATE command to establish and size the file properly without operator intervention. If you must adapt the program to a different dialect of BASIC, you may have to rearrange the file structure.

You can make as many files using this option as you desire, one for each set of books you want to keep. Just be sure to give each file a different name so you don't accidentally update the wrong files.

Start a new year. Option 2 resets balances and pointers within the file. For each account, the current balance and the year-to-date balance are set to zero. The program also assumes that you will want to begin with a fresh source document for the coming year, so it sets the next line item number to one. Obviously, before you exercise this option you should be sure that you have recently produced a summary report, since the data will no longer be available on disk after this option.

Start a new month. Option 3 sets only the current balance figures to zero. It assumes that you will wish to continue following months with the same source document, so does not set the next line item number to

zero. Again, be sure you have already produced a summary report for the current period; if not, though, the current expenses will be properly reflected in the year-to-date figures anyway.

Add data. Option 4 provides the data-entry capability for the system. For each entry, you must key in the amount and account number when coached on the screen. To finish the process simply enter zero for the account number, and you will be returned to the option menu.

If you make a mistake in data entry, simply enter an offsetting entry (i.e., same account number and a negative number). By the way, you don't have to worry about negative numbers to distinguish expenses from income entries; all entries are positive numbers and are distinguished within the program by the account descriptions you provided when constructing the file initially.

Print monthly summary. Option 5 provides the printed monthly summary, as shown in Fig. 2. You are asked for the month, which shows up at the top of the printout. Other than that, operation proceeds without operator intervention, except for loading the paper when asked.

Help, Print source document and Quit the program. The last three options are direct and to the point. Option 6 simply displays at the screen a few reminders about the program in case the user is having some trouble. Option 7 prints the source document shown in Fig. 1, starting with the line item number specified by the user. Option 8 merely provides an orderly way to get out of the program and back to BASIC, so he can play games or whatever.

Conclusion

Keepbook is a simple bookkeeping system that meets my needs for both personal and business financial management. It is written in North Star BASIC, release 4, but can easily be adapted to earlier versions of that dialect, and perhaps not so easily to other BASIC dialects.

In its present form the program assumes that you have both a printer and a video display. If you have only a printer, you need only change the device numbers in the initialization block of the program so that both devices (D0 and D1) have the same value. If, on the other hand, you have only a video device, this may not be the ideal program for you.

I hope some of the readers of *Microcomputing* try Keepbook. I would be especially interested in hearing from anyone who adapts the program to another version of BASIC. ■

Vector Graphing Techniques (North Star with Merlin)

Wendell Brown, 18, has been active in the computer field for over 12 years. He is manager of Low-Cost Computer Services in Oneonta NY, and serves as a professional consultant.

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The computer will no doubt continue to share an increasing part in our everyday lives. The need for interaction between human and computer will be of greatest concern. This article will present some solutions to problems relating to computer graphics.

Specifically, the primary focus here is on vector graphics and how to obtain smooth and continuous-looking lines on graphs. Efficient software techniques are used to fill gaps between data points in the creation of lines. Several different procedures to maximize program and drawing speed are also presented.

The Problem

Smooth-looking lines are a necessity for most business and quality hobbyist graphic systems. The hardware cost for excellent graphics is perhaps high, but you can get very good results using a little hardware and suitable software at a lesser cost. The trick is designing the software to fully utilize the hardware.

An example of high-efficiency matching between hardware and software is the video arcade game. The graphics, analog-to-digital converters and sound output are all well designed into the software. The result is fabulous video output at minimal cost.

A common problem of graphics, often found in higher-level languages, is skip. This occurs when only line segments or dots are displayed to represent whole lines (see Program A and Photo 1). Skip not only distorts the curve but makes the display appear choppy as well. Although not all information can be smoothly shown (or should be), many displays can be greatly improved with little effort and time.

Another problem in curved graphics is the use of straight lines to approximate the curve. This is more of a technique than a problem, and the ability to circumvent these lines is based solely on the extent of the hardware and software. Obviously, the more lines there are, the higher the approximation of the curve. However, the more lines there are (hence shorter lines), the more time required to draw out the curve.

Techniques of Solution

Eliminating skip requires filling in the gaps between dots. This can be done in several ways:

1. In the event that there is an equation, the domain of the equation (input) can be increased. This will result in more outputs calculated, and thus more dots represented.

2. Another way is to draw short lines between dots. These lines connect all the dots to-

Photo 1. Skip graphics.

```
10  FOR X = -15 TO 15 STEP .5
20  IF X=0 THEN 80
30  Y=SIN(X)/X
40  X1=INT(80+5*X)
50  Y1=INT(80-70*Y)
60  REM NOW PLOT THAT POINT (A9 IS JUST JUNK)
70  A9=FNX(X1,Y1)
80  NEXT X
90  STOP
```

Program A. Run time—8 seconds.

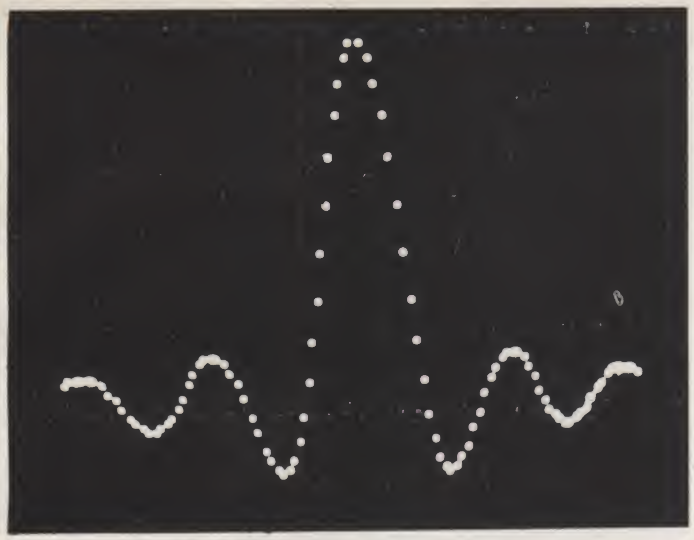

Photo 2. Increasing the domain of the equation.

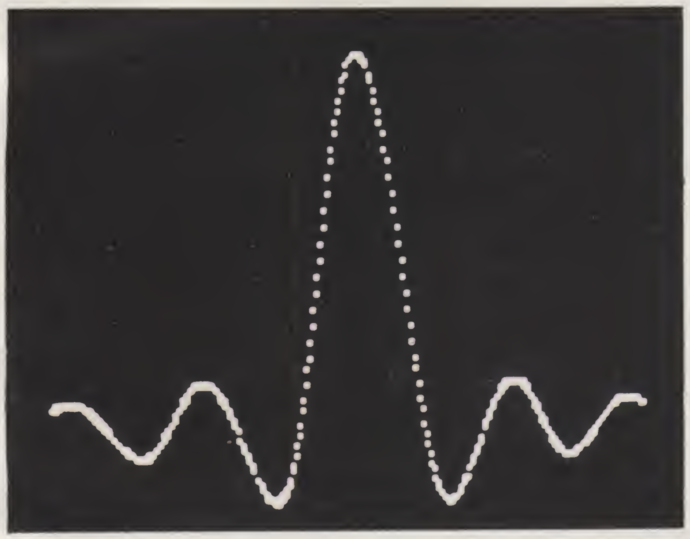

Photo 3. Decreasing skip.

```
10  FOR X = -15 TO 15 STEP .2
20  IF X=0 THEN 80
30  Y=SIN(X)/X
40  X1=INT(80+5*X)
50  Y1=INT(80-70*Y)
60  REM NOW PLOT THAT POINT (A9 IS JUST JUNK)
70  A9=FNX(X1,Y1)
80  NEXT X
90  STOP
```

Program B. Run time—17 seconds.

```
5     X2=5:Y2=76
10    FOR X = -15 TO 15 STEP .1
20    IF X=0 THEN 80
30    Y=SIN(X)/X
40    X1=INT(80+5*X)
50    Y1=INT(80-70*Y)
60    GOSUB 1000
70    X2=X1:Y2=Y1
80    NEXT X
90    STOP

1000  IF X1=X2 THEN 1080
1010  A=(Y2-Y1)/(X2-X1)
1020  B=Y1-A*X1
1030  FOR X3=X1 TO X2 STEP SGN(X2-X1)
1040  Y3=INT(B+A*X3)
1050  REM NOW PLOT THAT POINT (A9 IS JUST JUNK)
1060  A9=FNX(X3,Y3)
1070  NEXT X3
1080  RETURN
```

Program C. Run time—46 seconds.

gether, creating continuity.

3. Still another way is to evaluate the equation (or a line equation) in an inverse way. For example, the y-axis value is usually calculated from an equation using the x-axis value as its domain (input). In this inverse line method, the x-axis value would be calculated from a value on the y-axis.

Solutions

As described above, an increase in the number of points plotted will definitely decrease the occurrence of skip. Unfortunately, the more points you plot, the more time the program will take to plot the entire graph. This is especially true with long, time-consuming equations. Moreover, the chance of skip is only reduced, not eliminated. No matter how often you plot calculated points, there is still an excellent chance of near-vertical lines, thus creating skip somewhere in the graph.

Program B shows increased domain. Note that over twice the number of points are calculated and plotted (line 10) and skip is reduced. However, skip still occurs, giving the graph an incomplete and inferior look (Photo 2).

To draw lines between dots, you must determine the equation of the line. If you know two points—in the form of Cartesian coordinates, (X_1,Y_1) and (X_2,Y_2)—then you can equate the line:

$$A = \text{slope} = \frac{Y_2 - Y_1}{X_2 - X_1}.$$

$$B = Y - \text{intercept} = Y_1 - AX_1$$

In this case, you would draw the line from the first point (X_1,Y_1) to the second point (X_2,Y_2). Program C is an example of this type of solution. A slight problem occurs with this method: to determine the number of points to plot on the line.

In the normal graphing of a line, the line equation is given a certain point on the x-axis as input. The equation then computes the corresponding value on the y-axis as output. The point with these X and Y coordinates is then plotted on the graph. If that y-axis value is close to the value of the previous point, then the graph in that neighborhood will look good.

However, in many equations the y-axis value is not numerically and graphically close to nearby y-axis values. This is especially true in functions that fluctuate rapidly. In these functions the y-axis value may skip either up or down, thus creating skip in the graph.

The most effective way to avoid skip is to invert the line equations' input and output to enable drawing two short lines between the two dots . . . once using the x-axis as the line equations' domain, and again using the y-axis as domain. To do this, you must mathematically invert the line equation from above. This is a simple procedure.

First, you must calculate the slope and y-intercept of the line between the two dots as shown above. The program then plots that line in the normal way using the x-axis as domain. You then plot the inverted line using the y-axis as domain. To do this, you must derive the inverted line equation as below. For example, if you have the general line equation:

$$Y = AX + B$$

all you have to do to invert the equation is to solve it for X:

$$X = \frac{Y - B}{A}$$

```
5    X2=5:Y2=76
10   FOR X= -15 TO 15 STEP .1
20   IF X=0 THEN 80
30   Y=SIN(X)/X
40   X1=INT(80+5*X)
50   Y1=INT(80-70*Y)
60   GOSUB 1000
70   X2=X1:Y2=Y1
80   NEXT X
90   STOP

1000 IF X1=X2 THEN 1100
1010 A=(Y2-Y1)/(X2-X1)
1020 B=Y1-A*X1
1030 FOR X3=X1 TO X2 STEP SGN(X2-X1)
1040 Y3=INT(B+A*X3)
1050 REM NOW PLOT THAT POINT (A9 IS JUST JUNK)
1060 A9=FNX(X3,Y3)
1070 NEXT X3
1100 IF Y1=Y2 THEN 1180
1110 A=(X2-X1)/(Y2-Y1)
1120 B=X1-A*Y1
1130 FOR Y3=Y1 TO Y2 STEP SGN(Y2-Y1)
1140 X3=INT(B+A*Y3)
1150 REM NOW PLOT THAT POINT (A9 IS JUST JUNK)
1160 A9=FNX(X3,Y3)
1170 NEXT Y3
1180 RETURN
```

Program D. Run time—54 seconds.

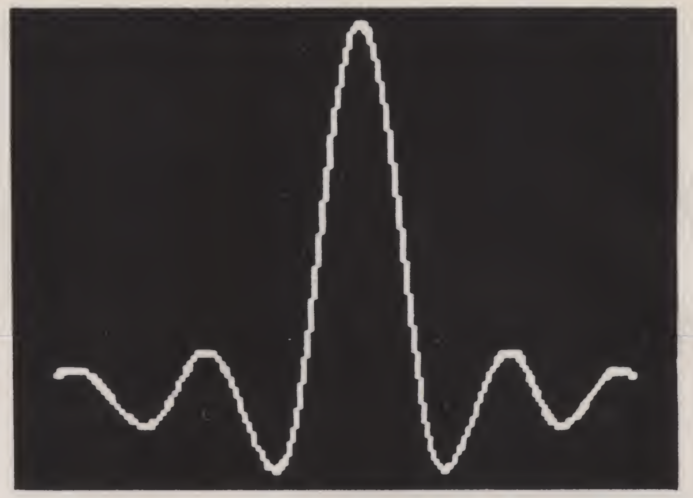

Photo 4. Filling the gaps.

By drawing the line twice, you get a much better plot (see Photo 4). Because the line is dependent on both axes, the increment for the line calculations will be one on both axes. This, in effect, is insurance that we will avoid skip.

Moreover, this line technique will allow us to increase the spacing between calculated points, thus saving computer time. For example, if we change the STEP value in line 10 of Program D from .1 to 1, we still get an excellent-looking graph with a run time of only 15 seconds.

In sum, since we are drawing lines and connecting all the dots, we can decrease the number of dots and still get a complete line. However, the fewer data points that there are, the less precise will be the continuous line.

The Program

Program D, written in 8-digit North Star BASIC version 6.3, is a general-purpose program useful in a variety of applications. This particular program uses MiniTerm's Merlin video interface board, set to use in its dense graphics mode.

The function FNX is a BASIC function used to calculate, FILL and thus graph the specific memory bit corresponding to whatever (X,Y) coordinate is input to the function (the Merlin uses a DMA display technique, that is, the data on the screen is directly representative of the memory being displayed or "mapped"). You can replace the FNX function by the SET function in Radio Shack's TRS-80 BASIC to accomplish the same thing (i.e., line 1060 in Program D would then become 1060 SET(X3,Y3)).

However, be careful not to exceed the display's edges. The Merlin, in its dense mode, has a graphics array of 160 × 100, while the TRS-80 has a 128 × 48 array. Similiar commands in most other BASICs will perform the same operation depending on what BASIC and what graphic equipment you have.

The way the programs were written requires an independent graphic display (memory). In other words, you must be able to access any point on the graph at any time. To run this program on a machine that displays (prints) only a portion of the graph at a time (e.g., TTY), you must make certain modifications to the program. A possible technique might be to set up an array and "graph" the array before any printing is done. After the graph is completed in memory, you would then plot out the entire array on paper. ■

Reader Service—see page 179

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Putting the 1802 on the S-100 Bus

1802 fans! If visions of simplified expansion are dancing in your heads, this one's for you.

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Like a lot of people, I got started with microprocessors by building an Elf. The Elf is a simple computer based on RCA's CMOS microprocessor, the 1802. The original device provided for data entry with toggle switches and had a two-digit hex display for readout. All programming was done in machine code. In other words, the computer was as simple and inexpensive as you could get.

Having been bitten by the microprocessor bug (or whatever it is that overcomes a person about these things), I immediately began adding bits and pieces of hardware here and there, more or less at random, dreaming all the time of the day I would be able to play Star Trek.

Mary Sunshine is playing a Tiny BASIC version of Tiger Trouble (sorry the display didn't show up—being a non-photographer I haven't the foggiest about how to do that).

I would like to be able to say that after a careful design study and making all the proper system trade-offs, etc., I determined that the most efficient means of upgrading my Elf was to adapt it to the S-100 bus. What really happened was that about the time I finished hand-wiring my first 4K of memory (those who have done this will appreciate the effort involved), a friend offered to sell me an S-100 motherboard and 8K of RAM for $60.

I have since come to realize just how fortunate this was. Instead of an elaborate kludge, I now have a sensible little system. I have Tiny BASIC working on my system and am developing a general-purpose text editor.

Circuit Description

Fig. 1 is a block diagram of the CPU board. The system is based on a monitor ROM called UT4, which was developed by RCA for their evaluator board. UT4 contains a software UART that uses the Q output and the $\overline{EF4}$ input to provide a serial data link to the terminal.

Other than the 1802 and UT4,

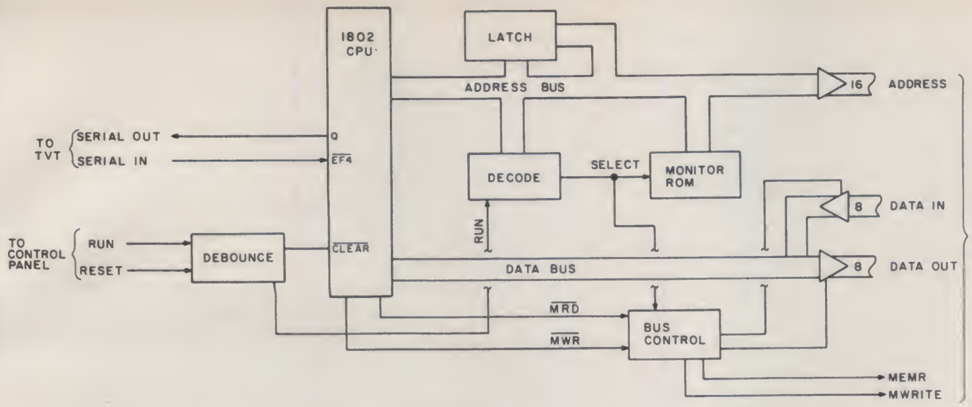


Fig. 1. Block diagram of 1802 CPU board.

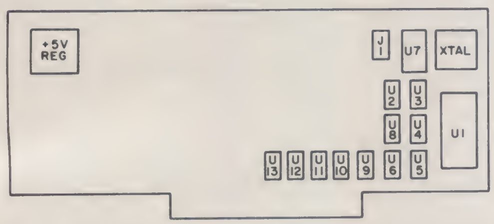


Fig. 2. Component layout on Vector 8800V board.

the board consists of simple control, latching, decoding and buffer circuits. In fact, the entire CPU consists of only 13 ICs, which can be wire-wrapped on a bare S-100 board in eight to ten hours. Fig. 2 shows the suggested board layout on a Vector board. Because of the low-power requirements of CMOS ICs, only one +5 V regulator is needed. The other regulator pad can be used to mount the crystal. A 16-pin DIP socket is used to take the control and serial interface signals off the board. Considerable space is left for future additions.

Fig. 3 shows the 1802 and associated control circuits. U2 serves to debounce the RUN and RESET switches and provides a RUN signal to the address latch to control start-up of the processor. The capacitor on the reset line provides power-up reset. The $\overline{\text{CLEAR}}$ line is used to select between the RUN and RESET modes of the 1802. The basic system makes no use of the LOAD or PAUSE modes, so the $\overline{\text{WAIT}}$ line is pulled high. Depending on the terminal device, the Q output and $\overline{\text{EF4}}$ input may require buffering, the addition of an RS-232 interface or the addition of a 20 mA current loop interface. The circuitry as shown will interface directly with an SWTP TVT.

Because the 1802 multiplexes the address as two sequential 8-bit words, it is necessary to latch the higher-order eight bits as shown in Fig. 4. Normally the 1802 starts (after RESET) at address 000H; however, the starting address of UT4 is at 8000H. So A7 is ORed with the RUN signal, which is high while the RUN switch is depressed. This allows direct entry into UT4.

Fig. 5 shows the address decoding for UT4. U6 uses MRD and the Q and $\overline{\text{Q}}$ outputs of the address latch to enable UT4 during a memory read between addresses 8000H and 81FFH. The $\overline{\text{CS}}$ signal is sent to the bus control circuits to disable the bus buffers when UT4 is addressed. Because UT4 is completely decoded, the entire remaining memory is available for use.

The bus interface is shown in Fig. 6. The S-100 bus signals are TTL, so drivers are necessary to convert the CMOS signals. U11, 12 and 13 buffer the address, MEMR and MWRITE signals. U9 and U10 are bidirectional bus drivers that buffer the data lines. Data input is enabled when the 1802 performs a memory read ($\overline{\text{MRD}}$ goes low), except when U14 is addressed ($\overline{\text{CS}}$ goes low).

This circuitry is all that is required for minimum CPU operations. The circuitry allows use of standard static RAM boards and I/O boards which are addressed as memory. Additional features of the 1802 and S-100 bus are not required initially. At the end of the article I have included some notes and suggestions about adding features.

Operation

Operation of the system is quite simple. After turning power on, the operator presses RUN and types in either a CR or an LF. CR initiates full duplex operation (the computer echoes input characters back to the terminal). LF initiates half duplex operation (no echo). UT4 automatically adjusts to the terminal baud rate and types an "*" as a command prompt. The 2 MHz crystal allows operation at 110, 150 or 300 baud.

UT4 Monitor

Use of the UT4 Monitor is also simple as there are only three commands—one to ex-

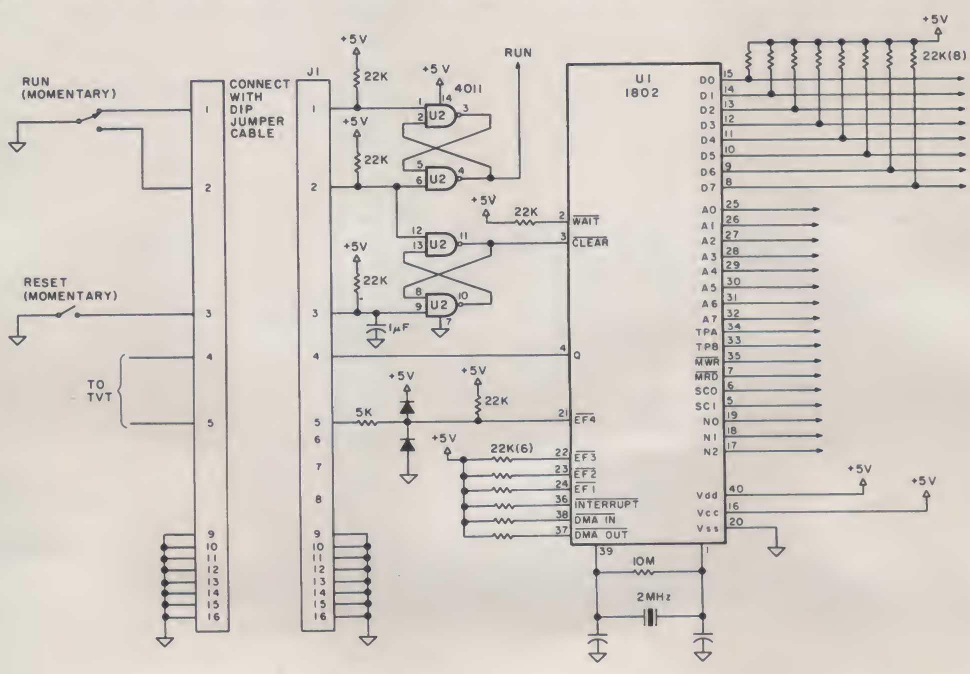


Fig. 3. CPU and control circuitry.

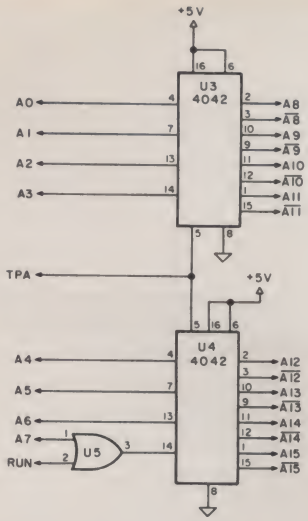


Fig. 4. Memory latch circuit.

Name	Address	Description
READ	813E	Input ASCII character to RF.1 and D.
READAH	813B	Same as READ. Also if character is a hex character it is converted to a 4-bit binary number and placed in RD. For instance, four inputs of hex characters 8000 from the terminal would leave RD with the value 8000H. This saves you the trouble of converting ASCII data to binary form.
TTYRED	8140	Same as READ. This routine is used to control a paper-tape reader. Calling this routine causes the CPU to issue a 67 instruction (OUT 7) and places 80H on the data bus. In the RCA system this turns on the paper-tape reader. After the character is read, a 67 instruction places a 40H on the data bus to turn off the paper-tape reader.
TYPE 5	81A0	Output ASCII character at M (R5) (memory location pointed to by R5), then increment R5. To use this function the character to be output is placed immediately following the SEP 3 instruction of the user program.
TYPE 5D	819C	Same as Type 5 except provides for a 1.5-bit delay of serial data. This is used when the preceding operation was a READ call.
TYPE	81A4	Output ASCII character at RF.1.
TYPE 2	81AE	Output hex digit pair in RF.1. This routine actually types out two ASCII characters. That is, each binary value in RF.1 is converted to an ASCII character and output to the terminal.
TYPE 6	81A2	Output ASCII character at M(R6) then increment R6. Use to output a data string.

Table 1.

amine memory, one to write into memory and one to initiate execution of a program. All numerical commands are in hex form; leading zeros are optional; and if more than four digits are entered, only the last four are used.

To examine memory enter the command:

?M address 'space' number 'CR'

where: address is a hex number specifying the starting address; number is a hex number specifying the number of bytes to be displayed. The monitor responds by typing out a four-digit address followed by data.

To modify memory enter the command:

!M address 'space' data CR

where: address is a hex number specifying the starting address; data is any number of hex digit pairs.

Non-hex characters in the data stream are ignored. An odd number of hex digits will cause UT4 to type a ? after a CR is entered. Lines may be continued by preceeding the CR with a comma or a semicolon. If a comma is used, simply keep typing hex pairs after the CR. If a semicolon is used, a new starting address must be specified after the CR (see Example 1).

The !M and ?M commands are designed to allow storage and retrieval of data through the terminal device. To record data use the following steps.

1. Enter ?M address space number (do not enter CR yet).
2. Start the recorder or tape punch.
3. Enter CR.

The monitor will output the desired data to the cassette or tape punch.

To load data, do the following.

1. Start up UT4 in the half duplex mode (no echo).
2. Enter !M0; (do not enter CR).
3. Start the recorder or tape reader.

The CR is recorded on the tape so the loading process will be preformed automatically.

The third monitor command is used to pass control to other programs. To use this command enter:

$P Address CR

where: Address is a hex number specifying the starting address of the program. When execution of the program begins, R0 is the program counter.

User programs may use the READ and TYPE routines within UT4 to provide terminal I/O. Steps for using the routines are as follows.

1. Make R5 the program counter.
2. Load starting address of appropriate READ or TYPE routine into R3.
3. For character output, load the character as required by the selected TYPE routine.
4. SEP to R3 (makes R3 the program counter).
5. When the routine is finished, control is passed back to

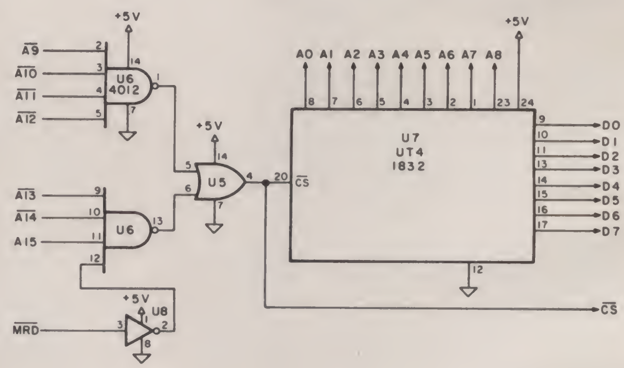
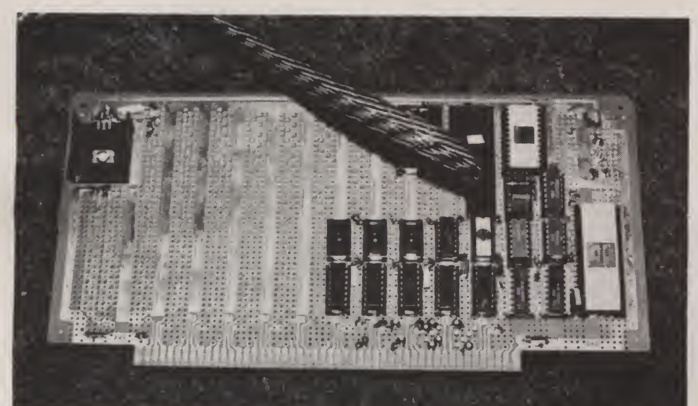


Fig. 5. UT4 and decode circuit.



Completed CPU board. Note the twisted-pair jumper cables used to connect to the control panel and the TVT. The extra sockets are for an expansion project I have in the works.

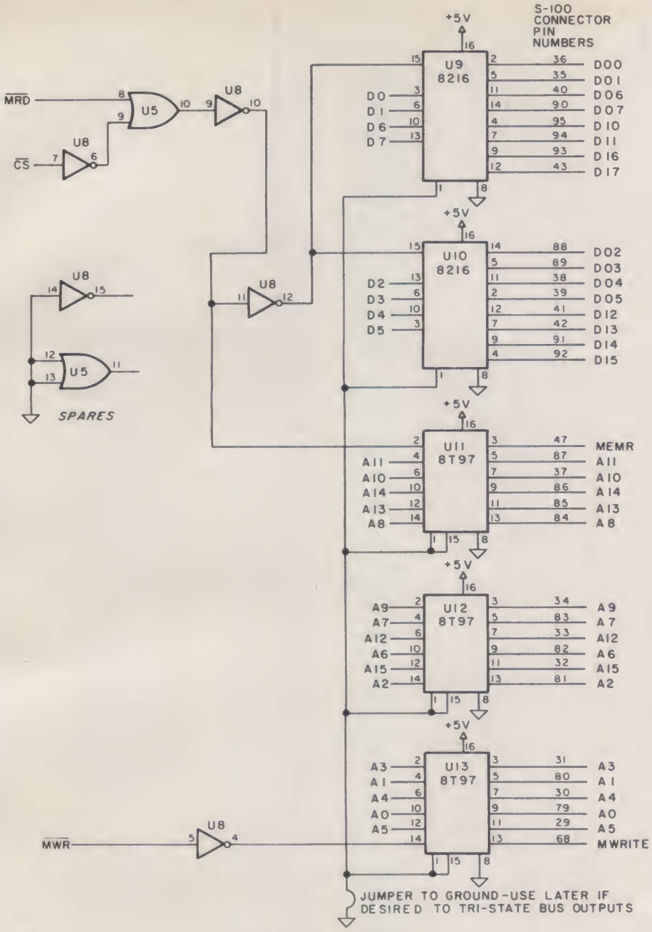


Fig. 6. Bus interface.

```
•!M100 0011 2233Z 4455  6677  8899,
AABB  CCDD  EEFF;
110 0011 2233
•?M100 14
0100  0011  2233  4455  6677  8899  AABB  CCDD  EEFF;
0110  0011  2233
```

The underlined characters are typed by UT4.

Example 1.

the program with R5 as the program counter.

6. For character input the character can be found as specified in the selected READ routine.

UT4 stores data used by these routines in registers RC and RE. Therefore, user programs must *not* use these registers. Also be aware that the READ and TYPE routines will change the contents of registers X, D, DF and RF.

Available routines and their entry points are shown in Table 1. READ and READAH exit with R3 pointing back at READAH. This means you can make successive calls to READAH without reloading R3 prior to each call. All TYPE routines exit with R3 pointing at TYPE 5. Thus, TYPE 5 can be used for successive calls.

Notes on Expansion

The CPU board, as described, is adequate to support Tiny BASIC and any machine-level programs of a purely computational nature. Use of many S-100-bus-compatible products may require that additional signals be generated. Also, it may be desirable to make use of some of the special features of the 1802. These features can be added piecemeal to fulfill specific requirements.

8080-type I/O works by addressing the I/O device with the lower eight address lines and providing I/O read (SINP) and I/O write (SOUT) signals. Fig. 7 shows how to simulate this operation. Whenever the memory immediately above UT4 (8200H to 8300H) is addressed for a memory read (or write), the MEMR (or MWRITE) signal is gated off and SINP (or SOUT) is generated. From a programming standpoint, the 8080 I/O instructions are shown in Table 2.

Note: The 8080 repeats the lower address byte to the upper address byte during an I/O operation. Unfortunately, some manufacturers decode the upper byte rather than the lower. Use of one of these products requires adding logic to allow the decode signal to gate the lower address onto the upper address lines.

The 1802 input/output operations pose a minor problem when using a split data bus. The reason for this can be seen in Fig. 8. During the input instruction the 1802 expects data to flow directly from the I/O device (which outputs onto the Data In bus) to memory (which inputs from the Data Out bus). Therefore, it will be necessary to add logic as shown to connect the two buses during an input operation (the MEMR line is low during an input).

Interrupts can be handled by connecting the $\overline{\text{INTREQ}}$ Line (Pin 75) to the 1802 $\overline{\text{INTERRUPT}}$

8080	1802
OUT XX	Any memory store instruction to 82XXH
INP XX	Any memory load instruction to 82XXH

Table 2.

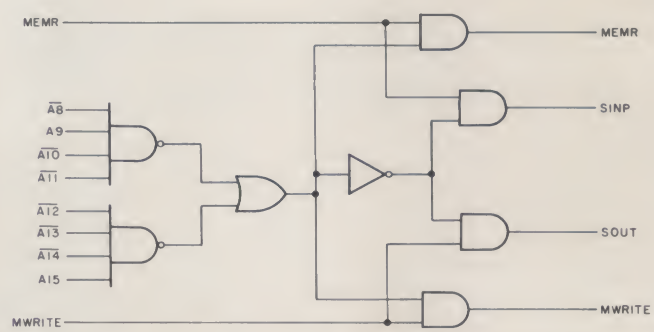


Fig. 7. 8080 I/O port simulation.

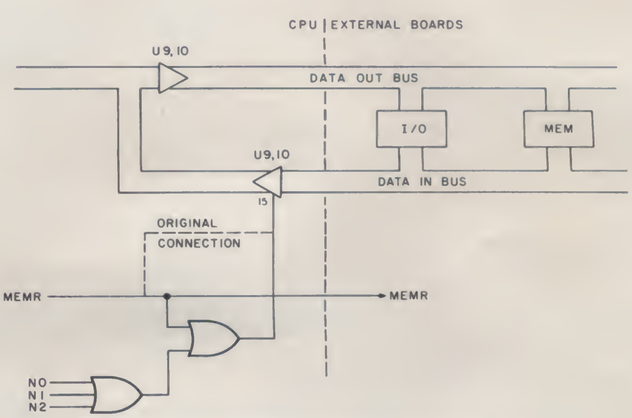


Fig. 8. Using N lines to connect data buses.

pin. Use on AND gate to drive INTA (pin 96) high when SCO and SCI are both high.

The S-100 DMA operations are normally initiated by the $\overline{\text{HALT}}$ signal (Pin 74), which stops the processor and disconnects the CPU from the bus. This can be copied by connecting $\overline{\text{HALT}}$ to the 1802 $\overline{\text{WAIT}}$ pin as shown in Fig. 9. The 1802 stops on the first falling edge of the clock so the 4013 is used to Tri-state the bus drivers and generate the HLDA signal (pin 26). When designing a DMA device from scratch, you can save considerable hardware by using the built-in DMA features of the 1802.

Table 3 shows the suggested assignment of 1802 signals to the spare S-100 bus signals. In addition, Fig. 10 shows the suggested memory map for 1802 systems.

The 32-byte RAM at 8C00H to 8C1FH is used by UT4 to store the CPU registers when UT4 is entered. A long branch to 8000H can be inserted into a program for debugging purposes. The values stored in RAM for R0, R1 and R4.1 will not be correct. Also, the memory immediately above 8C1FH cannot be RAM, else UT4 does strange things.

UT4 can be purchased through any RCA distributor. Ask for: UT4 Utility Program (CDP1832). Part No. CDPR512CD (4-6 V) is $13.30. Part No. CDPR512D (3-12 V) is $16.20.

Conclusion

I hope this article will help other 1802 users to upgrade their own systems with a minimum of effort. I have provided details on how to make an S-100 bus CPU board and described the use of a monitor ROM you can buy. The basic system is a "minimum" system in that it does not use all the features of either the 1802 or the S-100 bus. The idea is to keep things simple and allow for expansion as the need arises.

Other than the CPU board, you will need an S-100 bus motherboard, at least 4K of memory, power supplies and a terminal or TVT. Of course, you will want some software. For starters, Tiny BASIC is available from Itty Bitty Computers, PO Box 23189, San Jose CA 95153. ■

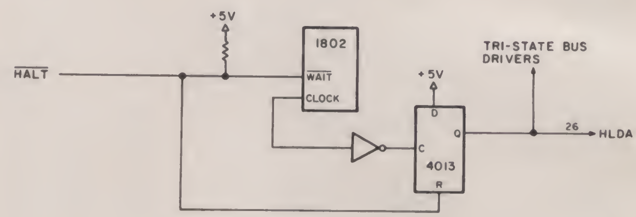


Fig. 9. Using the $\overline{\text{HALT}}$ signal.

SIGNAL	PIN
$\overline{\text{DMA IN}}$	61
$\overline{\text{DMA OUT}}$	62
SCO	63
SCI	64
TPA	65
TPB	66
$\overline{\text{EF3}}$	12
$\overline{\text{EF2}}$	13
$\overline{\text{EF1}}$	14
N0	15
N1	16
N2	17

Table 3. Assignment of 1802 signals to S-100 bus spare pins.

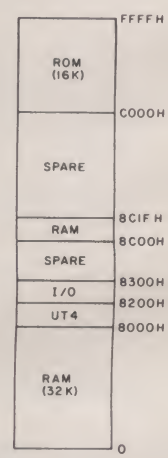


Fig. 10. Memory map.

A Personal Finance System

This 3-part series of personal finance programs can be used to keep track of payments, prepare tax returns and generally balance your budget. Part 1 covers accounts payable.

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The wild bill reared its ugly head. It was a hideous sight, covered with numbers and punched holes. Somehow it had escaped from the other bills and lain undetected under a pile of old newspapers, growing by 5 percent every month. Now it would take both barrels of the old elephant gun filled with cash to subdue it. There must be a better way!"

With the advent of the personal computer, there is no longer any reason for allowing bills that escaped into the jungles of paper on your desk to run wild, terrorizing you and your loved ones. Properly equipped, a microcomputer can all but eliminate cluttered files, and in so doing, greatly reduce the chance of overdue bills.

And while it appears that no one else is doing it, balancing the budget is still an important step in staying financially alive, a task that is much easier if the computer is keeping track of income and expenditure. Another advantage of the computerized bookkeeper is that it can help you prepare your tax return, and probably save you money in the process.

In this and subsequent articles, I will present a series of three programs that will keep track of due bills and the checks or cash by which they are paid, keep track of pay stubs and other income and provide several different reports that can be used in preparing tax returns and in balancing the budget.

All of these programs are written in ANSI standard CBASIC, a disk-based compiler sold by Digital Research. A minimum recommended system for running the programs consists of an 8080 microcomputer, a CRT console, a hard-copy printer, 24 kilobytes of memory and a single drive IBM-compatible floppy disk. Minimum required software includes the CP/M disk operating system and CBASIC, both from Digital Research.

If you have the recommended hardware, but do not have CP/M, I recommend it as probably the best and most inexpensive disk operating system available for 8080 microcomputers. Furthermore, it will work with any eight-inch IBM-compatible disk drive on the market, and that gives you a lot of models to choose from.

Though all of this may sound like a lot of very expensive equipment, actually the prices of both memory and disks are dropping like flies, and the printer is not absolutely necessary. The system is even more affordable when you consider that it will be saving you time, which in many cases is much more important than money.

Operation

The program accompanying this article is a personal accounts-payable system for keeping track of bills and their payment. This program keeps two files — one for those bills currently due and one containing records of payment of previous bills. When the program is run, it will ask for the date, after which it will print a list of options. To select an option, type its corresponding letter followed by a carriage return. The computer will prompt for all necessary information.

The first step in using the program is to make out a list of all companies from which you regularly receive bills. Enter the company names, one at a time, using the A option. As each company is entered, the computer will assign an account number, starting with the number one. Later, these numbers will be used in place of the company's full name.

It is best to enter bills as they are received. This will save having to go on a bill-hunting expedition at the end of each month. To enter a bill, invoke the F option. The computer will ask for the account number of the company that sent the bill. (This is the number that was assigned by the computer when the account was first created.) After you have entered the amount of the bill and the date it is due, the computer will print the new balance for that account. This is the sum of any previous outstanding balance and the amount of the bill just entered.

If you are a red, white and blue procrastinator like most sensible Americans, the G

```
A>CRUN ACC/PAY
CRUN VER 1.02

TODAY'S DATE? 03/04/78

ACCOUNTS PAYABLE SYSTEM                               DATE: 03/04/78



ALLOWABLE OPTIONS ARE:

A=ENTER NEW ACCOUNT                B=LIST CURRENT ACCOUNTS
C=LIST SPECIFIC ACCOUNT            D=LIST ACCOUNT HISTORY
E=PAY BILL                         F=ENTER NEW BILL
G=PRINT BILLS DUE THIS MONTH       H=WRITE CHECK (NOT FOR BILL)
I=EDIT AN ACCOUNT                  J=RETURN TO DISK OPERATING SYSTEM



OPTION (?=LIST OPTIONS)? A
ACCOUNT NUMBER  5 ASSIGNED
ACCOUNT NAME? NOMICE EXTERMINATOR

OPTION (?=LIST OPTIONS)? B
PRINT ON TTY? Y

 DATE: 03/04/78

ACN          ACCOUNT              TOTAL     BALANCE    DATE DUE
---- --------------------  --------- --------- ----------

  1   AQUA WATER WORKS         $17.95    $17.95    04/01/78
  2   XENON POWER CO.          $12.00    $12.00    03/22/78
  3   WATCHDOG INSURANCE       $48.50    $48.50    03/12/78
  4   BAD GUYS DEPT. STORE     $79.60     $0.00    01/27/78
  5   NOMICE EXTERMINATOR       $0.00     $0.00

------------------------------------------------------------
                                         $78.45
```

Sample 1. Initializations dialog and functions A and B.

the check, simply type a space followed by a carriage return.)

In the case of an error, the I option will allow individual records to be edited. Editing is done by fields so that the entire record need not be retyped. Decide which field is to be changed and enter its corresponding number (see Fig. 1). Then, retype that field.

You may, at any time, examine the history of an account by invoking option D. This will list the amounts, dates and check numbers of checks written to that account, as well as provide a total of the amounts.

The Program

The accounts-payable program was written in a structured format using subroutines for major operations. Most statements are also ANSI standard. These two features should make modification easier if you are running the program on other than the recommended sys-

option will be very handy. It lists only bills due the current month. However, if you are a more masochistic type, the B option will list all current accounts and print the total of your debts.

To pay a bill, use the E option. After you have entered the correct account number, the computer will print the balance due. Enter the amount of payment. If you are paying by check, also enter the check number. Finally, enter the date of payment. (If you wish to enter the current date as date of payment, simply type a space followed by a carriage return, and the computer will enter it for you.)

To record checks written for cash or miscellaneous, use the H option. If the check is of the miscellaneous type, enter the person or company who received it, as well as the check number, amount and date. (Again, to enter the current date as the date of

```
OPTION (?=LIST OPTIONS)? C
ACCOUNT NUMBER? 2
PRINT ON TTY? Y

ACN          ACCOUNT              TOTAL     BALANCE    DATE DUE

  2   XENON POWER CO.          $12.00    $12.00    03/22/78

OPTION (?=LIST OPTIONS)? D
ACCOUNT NUMBER? 1
PRINT ON TTY? Y

 DATE: 03/04/78

ACN          ACCOUNT              TOTAL     CHK NUM    CHK DATE
---- --------------------  --------- --------- ----------

  1   AQUA WATER WORKS         $17.40     100       01/10/78
  1   AQUA WATER WORKS         $20.79     102       02/20/78

------------------------------------------------------------
                               $38.19


OPTION (?=LIST OPTIONS)? E
ACCOUNT NUMBER? 3
ACCOUNT NUMBER   3 IS WATCHDOG INSURANCE
BALANCE DUE    $48.50
AMOUNT OF PAYMENT? 25.00
PAYMENT BY CHECK? Y
CHECK NUMBER? 105
DATE OF CHECK?      *** NOTE: SPACE ENTERED INSERTS CURRENT DATE ***

OPTION (?=LIST OPTIONS)? F
ACCOUNT NUMBER? 4
ACCOUNT NUMBER   4 IS BAD GUYS DEPT. STORE
AMOUNT OF BILL? 57.82
DATE DUE? 03/09/78
NEW BALANCE IS     $57.82
```

Sample 2. Functions C, D, E and F.

tem. In particular, two subroutines at lines 10000 and 11000 will probably need modification. These are the disk read record and write record routines, respectively.

CBASIC offers many extended features, and I have used them often in the program. These features include optional line numbers, long variable names and continuation lines (indicated by a backslash '\'). For this reason, I don't recommend running the program in anything other than an extended BASIC.

	Field #2	Field #3	Field #4	Field #5
1	Sears Roebuck Co.	$100.	$100.	01/01/78
2	Automobile Insurance	$75.	$75.	01/20/78

Fig. 1. Fields used by edit option.

IF conditional operators:

CBASIC	STANDARD	MEANING
EQ	=	equal to
GT	>	greater than
LT	<	less than
GE	>=	greater than or equal to
LE	<=	less than or equal to
NE	<>	not equal to

Special CBASIC statements:

OPEN "FILE" RECL 72 AS 1—Open a disk file named "FILE" for random access. Record length is fixed at 72 characters.

READ # 1,1;A$—Read into variable A$ from record 1 of random access file 1.

PRINT # 1,2;A$—Write variable A$ to record 2 of random access file 1.

LPRINTER WIDTH 72—All data will be printed on hard copy device instead of console. Line length is a maximum of 72 characters.

CONSOLE—All data will be printed on console device (opposite of above command).

In the routine beginning at line 7000 change:

IF MATCH(CHECK.DATE$,DUE.DATE$,1)GT 0

to:

IF LEFT$(DUE.DATE$,2)EQ LEFT$(CHECK.DATE$,2)

Fig. 2. A guide to modifications.

With regard to disk operations, random file access was used exclusively throughout the program, mainly for speed. Record length was set to 72 characters, indicated by the RECL 72 clause of file open statements. Both of the above features may be changed without seriously affecting operation of the program.

Formatted print statements were also used in the program to enhance output. These may be replaced with conventional print statements if print using is not available in your version of BASIC. For more information on how print using statements work, along with information on random and sequential file access and other extended features of BASIC, I recommend *Advanced BASIC: Applications and Problems* by James S. Coan (Hayden Book Co., 1977, $7.95).

I can't offer any guarantees, but it looks as though the program could be easily modified to run in the following BASIC languages:

Disk Extended BASIC by Mits
Disk BASIC etc. by Binary Systems
BASIC-E by Digital Research
Disk BASIC by North Star
Disk BASIC by Ohio Scientific
Disk BASIC by SWTP

For more information on special CBASIC statements and how to change them to suit your system, see Fig. 2.

Conclusion

In the coming years, microcomputers will have a tremendous impact on personal finance, an area of universal concern where a computer could be truly useful. Armed with this powerful tool and a little ingenuity, we may well make wild bills a thing of the past, something for the kids to see at the zoo. So come on, put your computer to a really worthy use. Happy hunting! ■

```
OPTION (?=LIST OPTIONS)? G
PRINT ON TTY? Y

ACN          ACCOUNT            TOTAL     BALANCE    DATE DUE
----  --------------------  ---------  ---------  ----------

  2   XENON POWER CO.          $12.00     $12.00    03/22/78
  3   WATCHDOG INSURANCE       $48.50     $23.50    03/12/78
  4   BAD GUYS DEPT. STORE     $57.82     $57.82    03/09/78

-----------------------------------------------------------
                                          $93.32

OPTION (?=LIST OPTIONS)? H
FOR CASH OR MISCELLANEOUS? MISC
CHECK FOR WHAT? KILOBAUD SUBSCRIPIION       *** NOTE MISPELLING ***
AMOUNT OF CHECK? 195.00
CHECK NUMBER? 106
DATE WRITTEN?       *** NOTE: SPACE ENTERED INSERTS CURRENT DATE ***

OPTION (?=LIST OPTIONS)? I
CURRENT ACCOUNT TO BE EDITED? NO
ACCOUNT NUMBER? -1

 -1   KILOBAUD SUBSCRIPIION  $195.00     106      03/04/78

THIS TO BE EDITED? Y
CHANGE WHAT FIELD? 2
RETYPE FIELD 2 ? KILOBAUD SUBSCRIPTION     *** MISPELLING CORRECTED ***
```

(Note my sense of humor.)

```
OPTION (?=LIST OPTIONS)? J
```

Sample 3. Functions G, H, I and J.

Program listing.

```
100   REM ****************
      REM PERSONAL ACCOUNT SYSTEM
      REM
      REM JAMES MCCLURE
      REM JANUARY 1978
      REM ****************
      REM THESE NEXT FEW LINES CHECK TO SEE IF THE TWO DATA FILES
      REM EXIST. IF NOT, THEY ARE CREATED AND INITIALIZED TO EMPTY.
      IF END # 1 THEN 150
      OPEN "CURRENT.DAT" RECL 72 AS 1
      GOTO 175
150   CREATE "CURRENT.DAT" RECL 72 AS 1
      PRINT # 1,1;2
      CLOSE 1
      CREATE "HISTORY.DAT" RECL 72 AS 1
```

```
        PRINT # 1,1;2
175     CLOSE 1
        REM FORMAT STRINGS
        HD$="ACN         ACCOUNT                TOTAL     BALANCE   DATE DUE"
        HC$="ACN         ACCOUNT                TOTAL     CHK NUM   CHK DATE"
        F3$="ACCOUNT NUMBER ### IS /..................../"
        SP$="---- --------------------  --------- --------- ----------"
        TR$="-----------------------------------------------------------"
        F1$="###   /..................../$$####.## $$####.##   /......../
        F2$="###   /..................../$$####.##   #####     /......../
        INPUT "TODAY'S DATE?";DATE$
200     PRINT
        PRINT "ACCOUNTS PAYABLE SYSTEM";TAB(50);"DATE: ";DATE$
        PRINT:PRINT:PRINT:PRINT
        PRINT "ALLOWABLE OPTIONS ARE:"
        PRINT
        PRINT "A=ENTER NEW ACCOUNT";TAB(40);"B=LIST CURRENT ACCOUNTS"
        PRINT "C=LIST SPECIFIC ACCOUNT";TAB(40);"D=LIST ACCOUNT HISTORY"
        PRINT "E=PAY BILL";TAB(40);"F=ENTER NEW BILL"
        PRINT "G=PRINT BILLS DUE THIS MONTH";TAB(40); \
                "H=WRITE CHECK (NOT FOR BILL)"
        PRINT "I=EDIT AN ACCOUNT";TAB(40); \
                "J=RETURN TO DISK OPERATING SYSTEM"
        PRINT:PRINT:PRINT:PRINT
300     INPUT "OPTION (?=LIST OPTIONS)?";OPTION$
        IF OPTION$="?" THEN 200
        OPTION=ASC(OPTION$)-64
        IF OPTION LT 1 OR OPTION GT 10 THEN 300
        ON OPTION GOSUB 2000,1000,3000,4000,5000, \
                6000,7000,8000,8100,8999
        CONSOLE
        PRINT
        GOTO 300
        REM ***************
1000    REM LIST CURRENT ACCOUNTS
        REM ***************
        GOSUB 9000
        OPEN "CURRENT.DAT" RECL 72 AS 1
        READ # 1,1;RECORDS
        PRINT " DATE: ";DATE$
        PRINT
        GOSUB 9100
        TOTAL=0
        FOR RECORD=2 TO RECORDS-1
                GOSUB 10000     REM READ RECORD
                TOTAL=TOTAL+BALANCE
                GOSUB 11500     REM PRINT RECORD
                IF (INP(0) AND 1) EQ 0 THEN 1800
        NEXT RECORD
1800    GOSUB 9200
        PRINT TAB(38);
        PRINT USING "$$####.##";TOTAL
        PRINT
        CLOSE 1
        RETURN
        REM ***************
2000    REM ENTER NEW ACCOUNT
        REM ***************
        OPEN "CURRENT.DAT" RECL 72 AS 1
        READ # 1,1;RECORDS
        PRINT USING "ACCOUNT NUMBER ## ASSIGNED";RECORDS-1
        ACCOUNT=RECORDS-1
        RECORD=RECORDS
        INPUT "ACCOUNT NAME?";ACCOUNT$
        TOTAL.DUE=0
        BALANCE=0
        DUE.DATE$=""
        GOSUB 11000     REM WRITE RECORD
        PRINT # 1,1;RECORDS+1
        CLOSE 1
        RETURN
```

```
        REM ***************
3000    REM LIST SPECIFIC ACCOUNT
        REM ***************
        INPUT "ACCOUNT NUMBER?";ACCOUNT.NO
        GOSUB 9000
        OPEN "CURRENT.DAT" RECL 72 AS 1
        RECORD=ACCOUNT.NO+1
        GOSUB 10000     REM READ RECORD
        PRINT HD$       REM PRINT HEADER
        PRINT
        GOSUB 11500     REM WRITE RECORD
        CLOSE 1
        RETURN
        REM ***************
4000    REM LIST ACCOUNT HISTORY
        REM ***************
        INPUT "ACCOUNT NUMBER?";ACCOUNT.NO
        GOSUB 9000
        OPEN "HISTORY.DAT" RECL 72 AS 1
        READ # 1,1;RECORDS
        TOTAL=0
        PRINT " DATE: ";DATE$
        PRINT
        PRINT HC$
        PRINT SP$
        PRINT
        FOR RECORD=2 TO RECORDS-1
                GOSUB 10000     REM READ RECORD
                IF ACCOUNT EQ ACCOUNT.NO THEN \
        PRINT USING F2$;ACCOUNT,ACCOUNT$,TOTAL.DUE,BALANCE,DUE.DATE$ :\
                TOTAL=TOTAL+TOTAL.DUE
        NEXT RECORD REM CONTINUE
        GOSUB 9200
        PRINT TAB(28);:PRINT USING "$$####.##";TOTAL
        PRINT
        CLOSE 1
        RETURN
        REM ***************
5000    REM PAY A BILL
        REM ***************
        INPUT "ACCOUNT NUMBER?";ACCOUNT.NO
        OPEN "CURRENT.DAT" RECL 72 AS 1
        RECORD=ACCOUNT.NO+1
        GOSUB 10000     REM READ RECORD
        PRINT USING F3$;ACCOUNT.NO,ACCOUNT$
        PRINT USING "BALANCE DUE $$####.##";BALANCE
        INPUT "AMOUNT OF PAYMENT?";PAYMENT
        INPUT "PAYMENT BY CHECK?";RES$
        IF LEFT$(RES$,1) EQ "N" THEN \
                CHECK.NO=0 :\
                INPUT "DATE OF PAYMENT?";CHECK.DATE$ :\
                GOTO 5100
        INPUT "CHECK NUMBER?";CHECK.NO
        INPUT "DATE OF CHECK?";CHECK.DATE$
5100    IF LEN(CHECK.DATE$) EQ 0 THEN CHECK.DATE$=DATE$
        BALANCE=BALANCE-PAYMENT
        GOSUB 11000     REM WRITE ADJUSTED RECORD
        CLOSE 1
        OPEN "HISTORY.DAT" RECL 72 AS 1
        READ # 1,1;RECORD
        TOTAL.DUE=PAYMENT
        BALANCE=CHECK.NO
        DUE.DATE$=CHECK.DATE$
        GOSUB 11000     REM WRITE HISTORY RECORD
        RECORD=RECORD+1
        PRINT # 1,1;RECORD
        CLOSE 1
        RETURN
        REM ***************
6000    REM ENTER NEW BILL TO BE PAID
        REM ***************
```

```
         INPUT "ACCOUNT NUMBER?";ACCOUNT.NO
         OPEN "CURRENT.DAT" RECL 72 AS 1
         RECORD=ACCOUNT.NO+1
         GOSUB 10000
         PRINT USING F3$;ACCOUNT.NO,ACCOUNT$
         INPUT "AMOUNT OF BILL?";TOTAL.DUE
         INPUT "DATE DUE?";DUE.DATE$
         BALANCE=BALANCE+TOTAL.DUE
         PRINT USING "NEW BALANCE IS $$####.##";BALANCE
         GOSUB 11000
         CLOSE 1
         RETURN
         REM ***************
7000     REM BILLS DUE THIS MONTH
         REM ***************
         GOSUB 9000
         OPEN "CURRENT.DAT" RECL 72 AS 1
         READ # 1,1;RECORDS
         CHECK.DATE$=LEFT$(DATE$,3)+"##/"+RIGHT$(DATE$,2)
         TOTAL=0
         GOSUB 9100
         FOR RECORD=2 TO RECORDS-1
                 GOSUB 10000
                 IF MATCH(CHECK.DATE$,DUE.DATE$,1)GT 0 THEN GOSUB 11500:\
                 TOTAL=TOTAL+BALANCE
         NEXT RECORD
         GOSUB 9200
         PRINT TAB(38);
         PRINT USING "$$####.##";TOTAL
         PRINT
         CLOSE 1
         RETURN
         REM ***************
3000     REM WRITE A CHECK FOR CASH OR MISC
         REM ***************
         INPUT "FOR CASH OR MISCELLANEOUS?";ACCOUNT$
         IF LEFT$(ACCOUNT$,1) EQ "C" THEN \
                 ACCOUNT=0:ACCOUNT$="CASH" \
         ELSE \
                 ACCOUNT=-1
         IF ACCOUNT=-1 THEN \
                 INPUT "CHECK FOR WHAT?";ACCOUNT$
         INPUT "AMOUNT OF CHECK?";TOTAL.DUE
         INPUT "CHECK NUMBER?";BALANCE
         INPUT "DATE WRITTEN?";DUE.DATE$
         IF LEN(DUE.DATE$) EQ 0 THEN DUE.DATE$=DATE$
         OPEN "HISTORY.DAT" RECL 72 AS 1
         READ # 1,1;RECORD
         GOSUB 11000     REM WRITE RECORD
         PRINT # 1,1;RECORD+1
         CLOSE 1
         RETURN
         REM ***************
8100     REM EDIT AN ACCOUNT RECORD
         REM ***************
         INPUT "CURRENT ACCOUNT TO BE EDITED?";RES$
         IF LEFT$(RES$,1) NE "Y" THEN 8200
         INPUT "ACCOUNT NUMBER?";ACCOUNT.NO
         OPEN "CURRENT.DAT" RECL 72 AS 1
         READ # 1,1;RECORDS
         RECORD=ACCOUNT.NO+1
         IF RECORD GE RECORDS THEN 8900
         GOSUB 10000
         PRINT
         GOSUB 11500
         PRINT
         INPUT "THIS TO BE EDITED?";RES$
         IF LEFT$(RES$,1) EQ "N" THEN 8900
         GOTO 8300
8200     IF LEFT$(RES$,1) NE "N" THEN 8100
         INPUT "ACCOUNT NUMBER?";ACCOUNT.NO
         OPEN "HISTORY.DAT" RECL 72 AS 1
         READ # 1,1;RECORDS
         FOR RECORD=2 TO RECORDS-1
                 READ # 1,RECORD;ACCOUNT
                 IF ACCOUNT.NO EQ ACCOUNT THEN 8250
8225     NEXT RECORD
         GOTO 8900
8250     GOSUB 10000
         PRINT
         PRINT USING F2$;ACCOUNT,ACCOUNT$,TOTAL.DUE,BALANCE,DUE.DATE$
         PRINT
         INPUT "THIS TO BE EDITED?";RES$
         IF LEFT$(RES$,1) EQ "N" THEN 8225
8300     INPUT "CHANGE WHAT FIELD?";FIELD
         PRINT "RETYPE FIELD";FIELD;
         IF FIELD EQ 2 THEN INPUT ACCOUNT$
         IF FIELD EQ 3 THEN INPUT TOTAL.DUE
         IF FIELD EQ 4 THEN INPUT BALANCE
         IF FIELD EQ 5 THEN INPUT DUE.DATE$
         GOSUB 11000
         CLOSE 1
         RETURN
8900     PRINT
         PRINT "ACCOUNT NOT FOUND"
         CLOSE 1
         RETURN
8999     STOP
         REM ***************
9000     REM TTY QUESTION
         REM ***************
         INPUT "PRINT ON TTY?";RES$
         IF LEFT$(RES$,1) EQ "Y" THEN LPRINTER WIDTH 72
         PRINT
         RETURN
         REM ***************
9100     REM PRINT HEADER
         REM ***************
         PRINT HD$
         PRINT SP$
         PRINT
         RETURN
         REM ***************
9200     REM PRINT TRAILER
         REM ***************
         PRINT
         PRINT TR$
         RETURN
         REM ***************
10000    REM RECORD READ SUBROUTINE
         REM ***************
         READ # 1,RECORD;ACCOUNT,ACCOUNT$,TOTAL.DUE,BALANCE,DUE.DATE$
         RETURN
         REM ***************
10500    REM RECORD READ FROM CRT SUBROUTINE
         REM ***************
         INPUT "ACCOUNT NAME?";ACCOUNT$
         INPUT "TOTAL AMOUNT DUE?";TOTAL.DUE
         INPUT "DATE PAYMENT IS DUE?";DUE.DATE$
         BALANCE=TOTAL.DUE
         RETURN
         REM ***************
11000    REM RECORD WRITE ROUTINE
         REM ***************
         PRINT # 1,RECORD;ACCOUNT,ACCOUNT$,TOTAL.DUE,BALANCE,DUE.DATE$
         RETURN
         REM ***************
11500    REM RECORD WRITE TO CRT SUBROUTINE
         REM ***************
         PRINT USING F1$;ACCOUNT,ACCOUNT$,TOTAL.DUE,BALANCE,DUE.DATE$
         RETURN
         END
```

Reader Service—see page 179

Building a New Horizon

After scanning the microcomputer landscape, this computerist settled on the Horizon.

Michael D. O'Brien
509 Jersey Lane
Security CO 80911

My search for a computer has ended in the purchase of a North Star Horizon II. The reason for my selection is strictly another story. This article is confined to the construction of the system and its highlights and shortcomings.

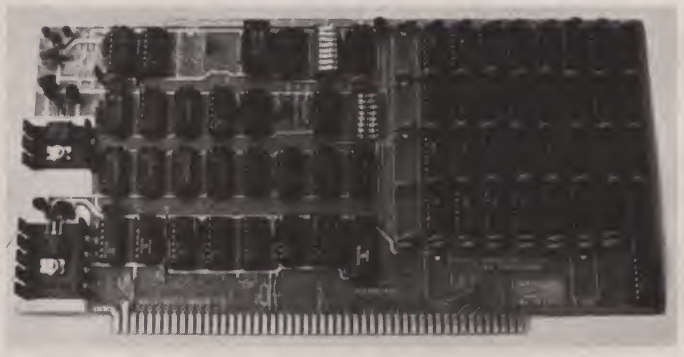
Introduction

Upon opening the inner box, I found a neatly packaged box that contained all of the parts in plastic bags. The Shugart drive was packed in its own Styrofoam unit and placed within the "protective hands" of the wood cover and the chassis sheet metal. Packaged in a double box, the unit was amply protected by two inches of space from all but the roughest shipper's hands. The quality is evident, right down to the heavy plastic parts bags.

Although the outer box was stamped "transformer may be in a separate box," the transformer was packed inside the inner box in a separate, heavy cardboard container. Presumably, the transformer would be packaged separately for a dual-risk configuration; the area vacated by the transformer would be used to pack the second disk drive.

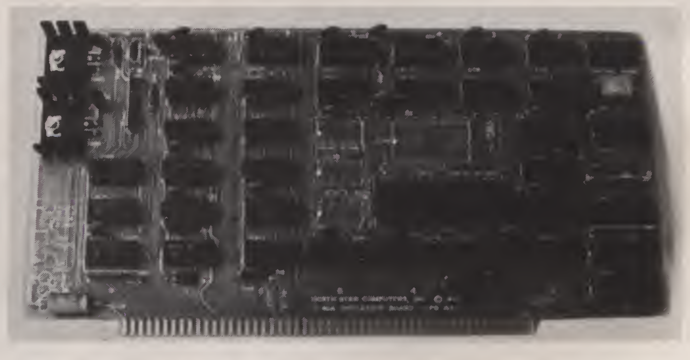
I know, I said that I bought a Horizon II and you want to know why I only received one drive. I bought a Horizon I and also bought the second drive at the same time to make a Horizon II. I also bought the system from a local source, and the only configuration they sell in one box is the single drive Horizon I. To get a Horizon II you must buy a Horizon I and buy the second disk unit at the same time to get the price for a Horizon II.

From experience, I have found that few companies are capable of error-free documentation. For this reason, you should follow North Star's instructions and read the entire assembly manual making pencil notes for any errata sheets

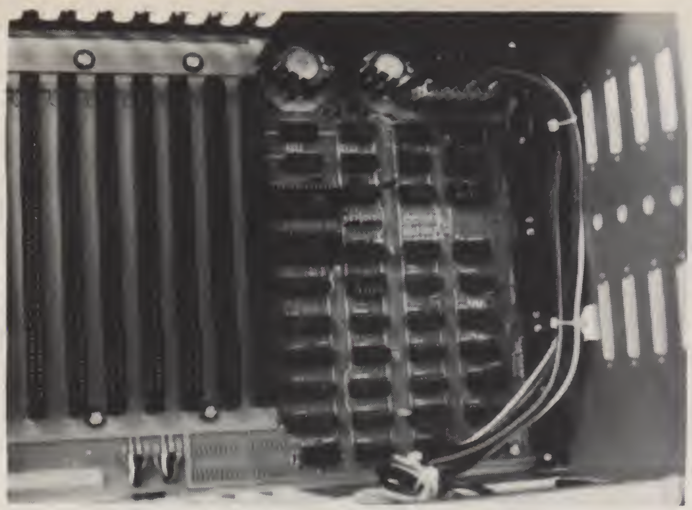


The 16K dynamic RAM board. It runs with zero wait states at 4 MHz.

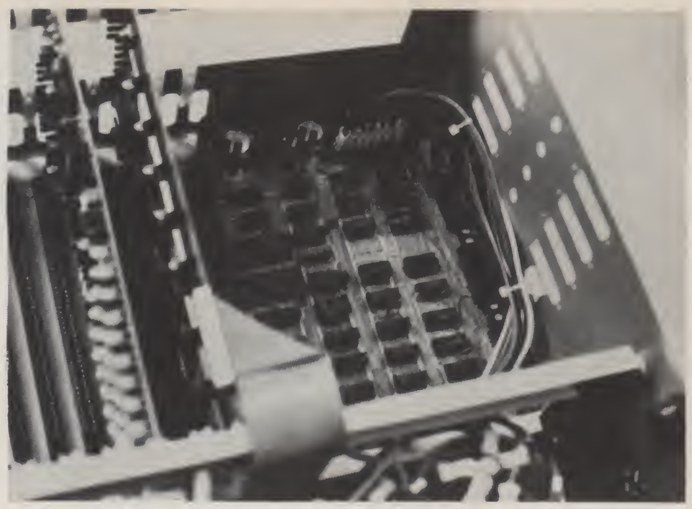
The finished product. Note the clean design and walnut veneer cover. I chose to adhere the name plate in the upper instead of the lower left-hand corner.



The completed Z-80 CPU board. The area enclosed within the dotted line in the central area of the board is for an optional, user-supplied PROM designed for "RESET and GO."



View of the fully populated motherboard. Note the heavy ground plane area between the 100-pin connectors.



The disk controller board with the ribbon cable attached must reside in slot nine. Note also the heavily heat-sinked regulators and the quick-disconnect power-supply leads.

included with your system. If ever I receive documentation without errata sheets, I write or call the company to verify that there are indeed no errors in their manuals. So far, I have not found an error-free manual.

Assembly

After I read the documentation, noting the errors, etc., it was time to clear a working area to build the system. Nothing fancy is required . . . just pick a place that is well-lighted and free from little gremlins and immaculate housekeepers.

As I proceeded to follow the directions, I found the instructions to be complete, with adequate photos of how the finished work should look. The only thing lacking, in my opinion, is little checkoff boxes to help you keep track of where you are (a la Heathkit).

The only tools required for assembly of the chassis/power supply are the usual assortment of screwdrivers, nutdrivers, pliers and a box wrench. The wrench is used to hold a couple of nuts in two or three hard-to-get-at places. It is also used to tighten the ¼ inch bolts that are used to anchor the transformer to the chassis.

Locating the correct wire for the power supply is extremely simple. North Star has provided pre-cut and crimped wires and terminals. You are only required to locate the wire according to length, color and terminal type and put a wire marker on one end of the wire. Locating components is easy too. Each plastic bag is marked with the name of the section you are working on at the time.

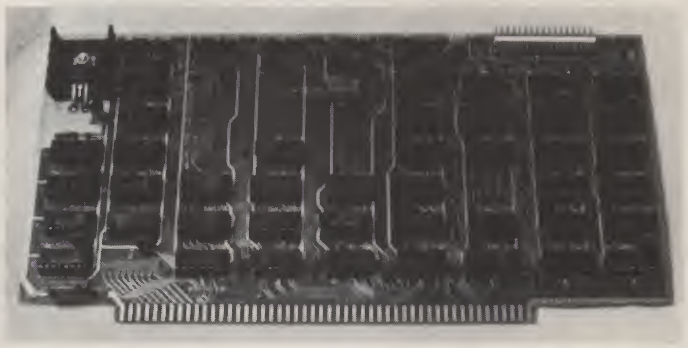
A quick look when you take an inventory will show the quality of the individual components. The printed circuit boards are double-sided with plated-through holes, soldermask and component orientation silk screening. The contact fingers are gold-plated, as are the IC sockets.

The disassembly, should it ever be necessary to remove the motherboard, is very simple. You need only pull the quick-disconnect wires and unfasten the mounting screws. The board slips right out of the chassis. This feature makes it easy to add a connector, serial or parallel I/O port (the motherboard handles two serial and a parallel input and parallel output port directly on the board itself).

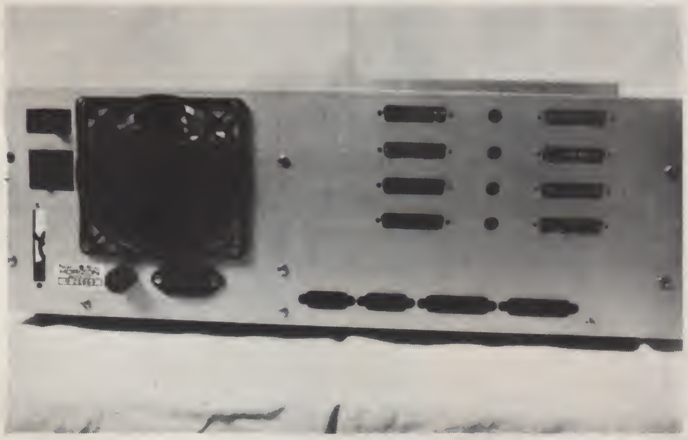
The assembly manual, if followed to the letter, will step you through the assembly and, at the proper time, tell you to check component orientation or measure voltages.

The sequence of assembly usually proceeds in the following order:

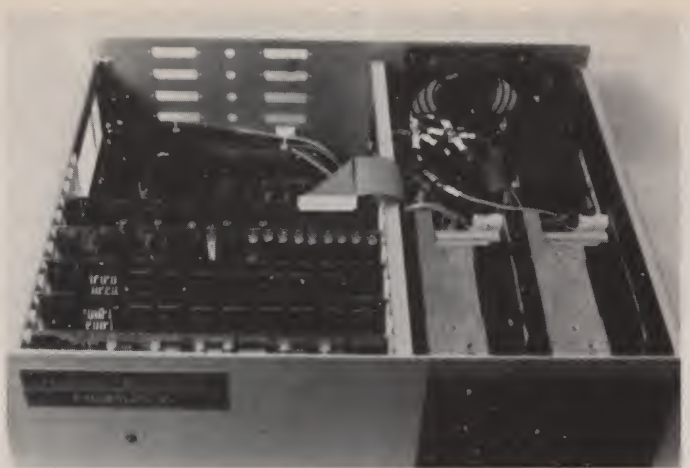
1. Assemble a portion of the circuit and check for shorts or opens with a volt-ohm milliammeter.
2. Measure voltages without components (ICs) in their sockets.
3. Insert components into their sockets and check for correct orientation. (Only TTL ICs are



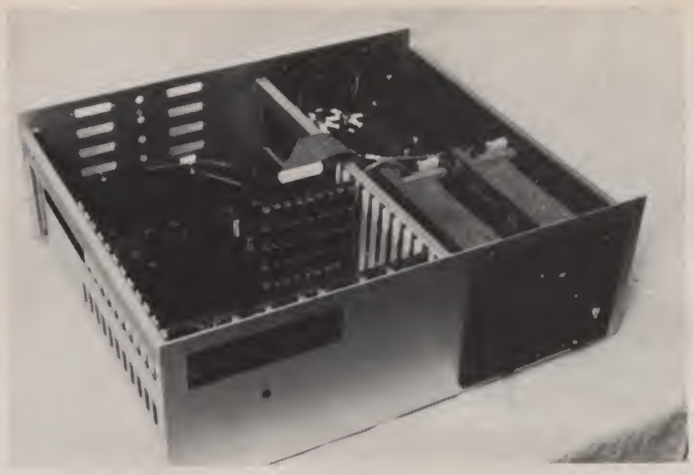
The completed disk controller board.



Rear panel view of the completed chassis. The upper-right side shows the eight cutouts for DB-25-type connectors and the four holes used for phono-type jacks. The lower-right area of the panel shows the two serial-port connectors on the right and the parallel-input and parallel-output connectors to the left of the serial port jacks.



The chassis with my current circuit-board configuration. The compact design and efficient layout are quite evident.



This is the "minimum configuration" for a dual-disk Horizon: two disk drives, chassis, power supply, CPU, 16K of dynamic RAM and a disk controller board.

The famed Econoram II from Godbout. Using static RAMs, it runs without wait states at 4 MHz.

inserted to this point.)
4. Measure voltages again.
5. Insert MOS/LSI components and check orientation.
6. Measure voltages.

This procedure basically illustrates that it is cheaper to replace TTL than MOS/LSI components if you have made an error. Usually, if you have made it to step three, there is only one mistake that you can make, and that is to put a chip in backwards.

At this point, the chassis and power supply have been assembled, and the motherboard has been checked and installed. The assembly manual next instructs you to refer to the assembly manuals for the Z-80 processor board and the 16K RAM board for their assembly, configuration and checkout. These manuals step you through the assembly in the same fashion as the Horizon assembly manual.

Checkout

To complete the assembly of your new system, build the disk controller board following the instructions in the main assembly manual. Again, the superb directions will just about prevent you from failing if you follow them exactly.

Now for the moment of truth. (Notice that I did not say "smoke test.") You continue to follow the instructions in the manual for the System Checkout Procedures.

Assuming that there are no errors in the software or any problems with the diskette itself, you are finally given directions to sit back, relax and pat yourself on the back for a job well done. And that, in truth, is exactly what happens. I know because I built a new Horizon and it worked the first time I tried.

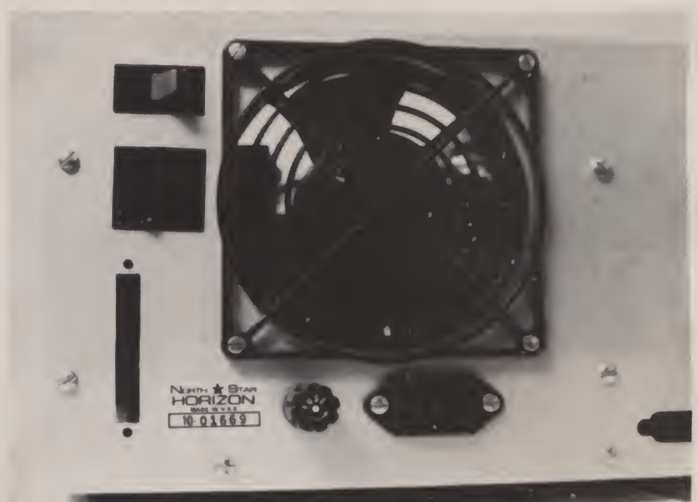
Kudos and Criticisms

Kudos go to North Star for their vision in several areas: First, the use of DIP headers to allow the system to be configured to the individual s needs. This includes the I/O ports for EIA or TTY (20 mA), the baud rates and the real-time clock. You can even configure the serial ports for synchronous operation should you desire. The second area is the rear panel. It comes prepunched for no less than eight DB25-type connectors, none of which are used for the standard serial port that is included with the system. Also, the back panel has punched holes for four circular connectors such as the RCS phono type.

If you are really going to expand, the addition of a third drive is easy. Although the third drive is not housed on the mainframe, expansion is a standard feature. There is a cutout on the rear panel for a connector into which the third drive's interface cable plugs. This will allow the system to be expanded without any messy cables between the cover and the metal chassis.

The Horizon has a cooling fan that is extremely quiet. In operation, the fan does its job without telltale offensive noise.

I mention a few criticisms as an addition to the documenta-



The cutout at the lower left is for the third disk-drive connector. The switch at the upper left is for reset. Just below that is the power switch. Under the fan is the integral ac connector and line filter.

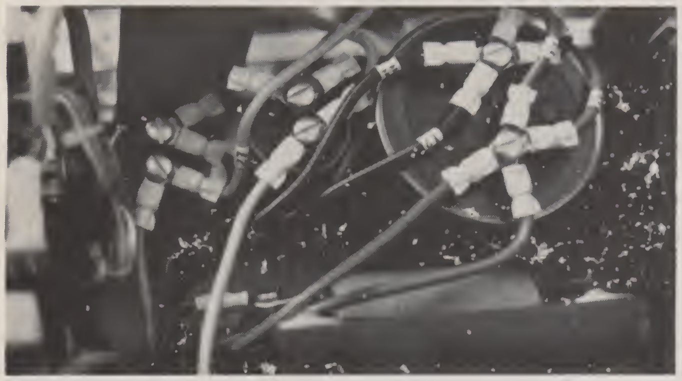
tion rather than due to a lack of information. My opinion is that North Star needs to include more step-by-step information for the novice. I think this statement requires an elaboration of the specific shortcomings that a novice might find difficult to understand.

First, the manual refers to "personalization" and the "personalized version of BASIC" in several places. This might lead a newcomer to believe that several changes or modifications must be made to BASIC in order to get the system checked out. It may not be obvious to the novice that to make for the right page of the manual.

My raising these points may make me appear a nitpicker, however, any time there is a possibility of confusion, the Gaelic lawmaker will strike.

I will reserve some other comments regarding the actual personalization of the software for a later time. North Star has announced the production of a manual called "North Star System Software," which will probably resolve those comments.

It is worth noting that I have personally witnessed the use of several S-100 compatible



The mighty power-supply filters. The pre-terminated wires make the assembly an easy task.

these changes to BASIC (to personalize it) requires an operational system.

Therefore, to check out the system, you must have the system properly configured and have a good copy of the software on diskette. Several possibly confusing points could be cleared up with the inclusion of a summary of items that must be accomplished prior to the actual start of the system checkout.

The addition of a table in the manual would also be helpful. This table should be a total listing of the possible DIP header configurations for the system. This would be useful because at the present time the configurations are scattered throughout the manual in different areas. The inclusion of a table would make it easier to change the configuration without bothersome searching boards in a Horizon. These boards included an ac controller, a Compu-talker and an automatic dialing modem. In addition, I personally use two Godbout 8K Econoram II boards running at 4 MHz with zero wait states.

Summary

I am quite pleased with the performance and capabilities of my Horizon II. The ease of construction, quality of material, flexibility of use and reasonable price make the North Star system worth owning. This statement is borne out by a North Star advertisement in the October 1978 issue of *Kilobaud*: "Over 10,000 users during the past two years have proven that North Star hardware has the reliability for day-in, day-out computing."

For my money, this is the way to build a new Horizon. ■

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Aiea HI 96701

Microcomputers and TVI

If you have ever encountered television interference—and what microcomputer owner hasn't had that happen at one time or another?—there is an effective way to combat it.

TVI does not stand for television interface, nor does it mean intentionally using your home TV as a graphics terminal for your computer. TVI does stand for television interference, and, like bad breath, many of us have it but don't know it . . . others of us know it but don't know what to do about it.

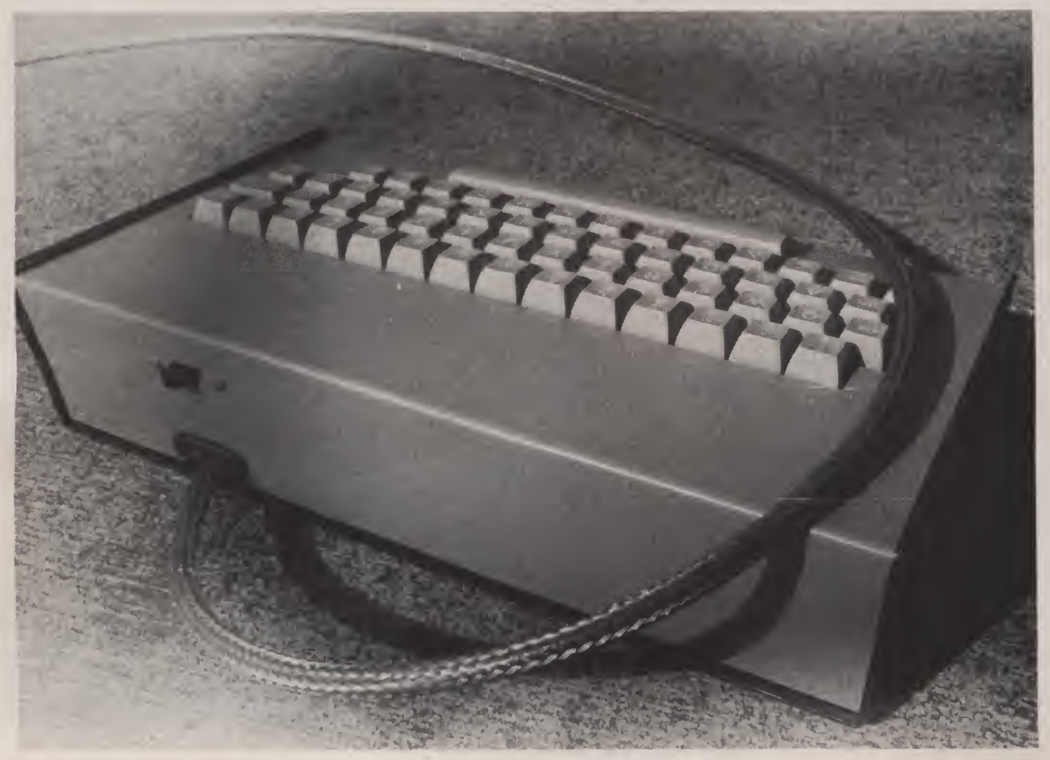
Television interference is an old enemy to us amateur radio operators. Amateur, and other, radio transmitters send out voice modulated signals that can be heard and understood on stereos, broadcast band radios and telephones and can be heard and seen on televisions.

Objective investigation has proven that the vast majority of this interference is the "fault" of receivers (stereos, TVs, etc.) that are not properly protected from strong radio frequency energy fields. Despite this, hams (and, recently, CB operators) have become the victims of neighborhood harassment, assaults and lawsuits because of interference seemingly caused by their equipment. Computer operators are luckier in some ways, but our situation is more perilous in others.

The Real Foe

As a young second lieutenant in the U.S. Air Force, I was fascinated by the burbles, squeaks and bursts coming from an ordinary AM radio when it was placed anywhere near the SAGE computer. But SAGE was huge—it used thousands of tubes with high voltage and signal levels and lots of power. (A three-story-block square building in Montana was heated with just the air blown over the 60,000 tubes!)

I was quite surprised, a dozen years later, to hear the identical sounds out of a radio across the room from my sophisticated low-power home computer. I was even more surprised to see the wavy lines moving across the test patterns of several local TV stations. I have now come to understand that computer CPUs, because of their high-speed operation, are dirty polluters of the radio energy spectrum. In several ways, this pollution, or interference, is worse than that caused by high-power radio transmitters.



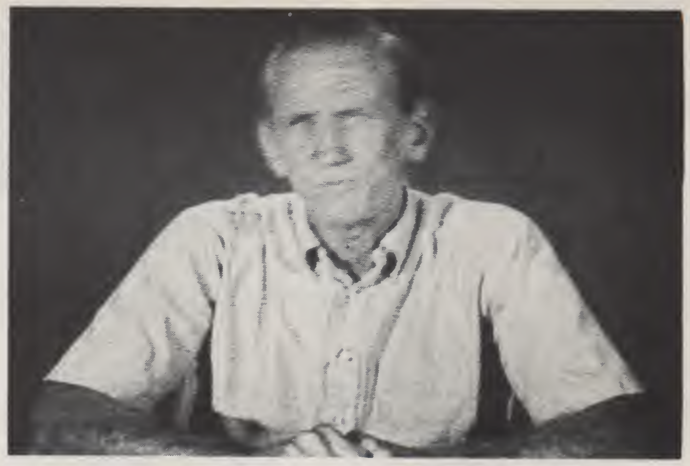
Radio operators are only interested in transmitting on one narrow frequency at a time; therefore, they can use sharply tuned circuits to reduce all other frequencies being generated. Computer operators want high speed, which means wide bandwidth and, hence, many frequencies being generated and mixed together with little attenuation. Some of these frequencies fall right into the bands that television sets and AM radios were designed to receive.

We cannot fall back on the claim that consumer-marketed receiving equipment is not properly protected from interference. Instead, we must recognize that we are infringing where we don't belong. Fortunately, our neighbors (and even our families) usually don't associate the lines marching across Donny and Marie's perfectly chiseled, gleaming teeth with our home computers, but if they ever do . . . hell hath no fury like an irate TV viewer.

Combatting TVI

Testing to determine if you have TVI is easy. Turn on your computer and your family TV set. Start the computer loading a lengthy program and check all of the TV channels. Interference from the computer will usually show up as a pattern of fine wavy lines across the picture from one or more TV sta-

With the switch off on a commercial Z-80-based microcomputer in the same room, the TV picture is free from interference.



Power on the CPU puts cross-hatch on the screen.

tions. If you see any sort of interference, shut down the computer and look again. If the interference disappears, you have a problem. If you don't have any interference, you are lucky . . . this time.

There are two places to attack television interference: at the computer and at the TV itself. Certain actions can be taken during the design of the computer printed circuit boards, and some component quality-control checks will decrease harmonic generation and radiation. As the industry matures, these changes will come about. I hope they will not have to be legislated or regulated by a governmental agency.

We can keep the radio energy that is produced tucked away where it cannot radiate. Four actions can be taken to contain radio energy: shielding, bypassing, choking, grounding.

Shielding

Almost all microcomputers on the market can stand to have their shielding improved. Those with substantial metal cabinets have the best basis for a "clean" operation. The cabinet itself should make a solid electrical connection between all of its parts. It may be necessary to scrape some paint off of the mating pieces and drill some holes for additional sheet metal screws to ensure this.

Manufacturers worry about proper cooling (as well they should), so they usually put in many holes or slots for air to pass through. These openings also let a lot of radio energy out.

The easiest way to plug these rf leaks is with good quality copper or aluminum window screen. The screen can be laid over the holes or slots without hampering the cooling; it should have plenty of overlap on the inside. The screen should be sturdily secured to the cabinet so that it makes a good electrical connection. Every gap or hole (including the fan hole) should be plugged the same way.

People with computers that have plain plastic or wonderful wood cabinets have a much larger task. Their best friend is heavy-duty aluminum foil. Aluminum foil and screening can be formed inside the cabinet and securely fastened with staples, tape or screws. Overlap and electrical connection between the shielding material and the cabinet is important. No space larger than one square centimeter should be left uncovered.

Bypassing/Choking

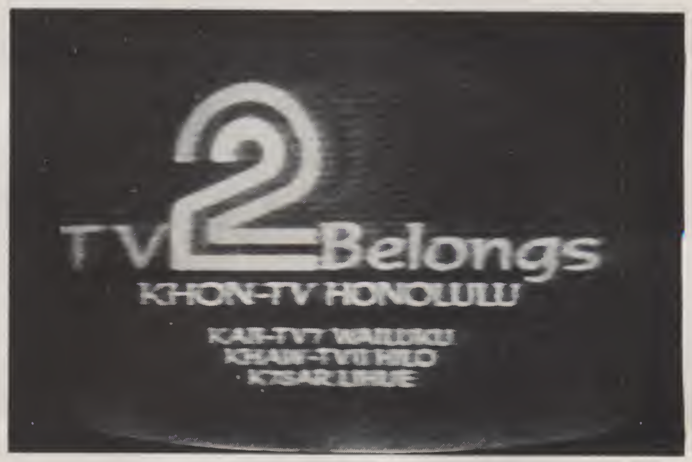
After the scraping, bonding and shielding, we can assume that the rf will stay in the cabinet if we don't provide it with any other means of escape. Unfortunately, we need to get data and power in and out of the machine. This means that connections and leads are needed for keyboards, tapes, disks, CRTs and the ac line. These leads serve as antennas that broadcast unwanted signals far and wide.

The ac power cable is the easiest, but also the most important, challenge. Three wire plugs (with the center pin grounded to the chassis) and internal bypass capacitors seem to be standard in the industry. You should check the visual appearance of the .01 or .05 uF capacitors that go from each side of the ac line to chassis ground. If they appear cracked or scorched, then the high ac duty cycle may have gotten to them, and they should be replaced.

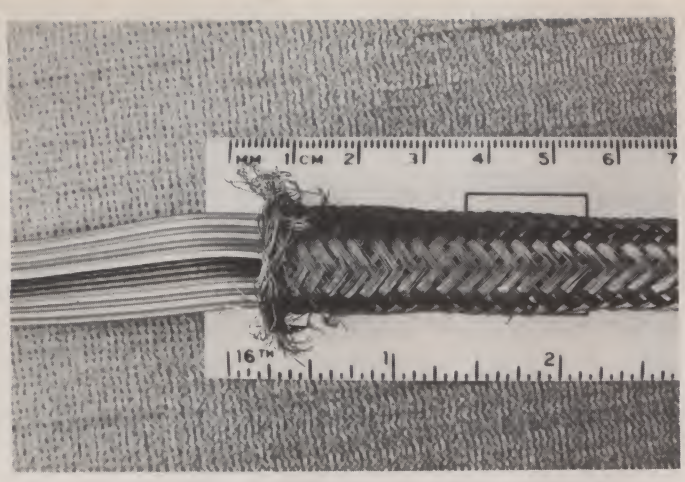
The bypass capacitors normally do a fine job of taking the rf off the ac line. If they aren't there or aren't functioning properly, the house wiring can become an ideal transmission and antenna system for radiating unwanted signals.

The video cable feeding the typical TV monitor is shielded coax, so any stray radiation should be contained within the shield. If an rf converter is being used to feed a standard TV set, the converter should be housed in a shielded box, and the input and output circuits should be arranged so that a minimum of coupling can take place between them. Do not attempt to shield the TV set in any way. That could be dangerous and unnecessary.

The cable going to a keyboard is difficult to deal with, but the leads going to floppy disks and other peripheral devices are the most difficult of



The pattern on this screen is typical of an interfering signal on or near the frequency of the TV station. This interference is caused by the harmonics of the 8080A CPU.



Copper braid from RG-8 coaxial cable is expanded to hold ribbon cable. Even though these cables usually have alternate grounded wires, full shielding greatly reduces radiation.

all. We could go for fancy bypassing and/or choking of each lead going to these devices, but we may create some very real problems with wave shapes and delay. I prefer the less elegant, but just as effective, method of shielding the entire cable.

Shielded multiconductor cable is expensive and often difficult to find. An effective substitute is easily made using the shielding from RG-8 or any other .4 inch coaxial cable. Hams and CBers in the neighborhood will often have short lengths of this cable around the house. Tell them that it starts to age and change its electrical properties after a few years (it does!) and that you would be happy to take some of the old stale pieces off their hands.

Use a sharp knife to slit the outer covering of the cable and peel it back like a banana. You can then press the braid together from each end and easily pull out the white coaxial inner conductor. Keep this braid fat and don't let it get flat. By trading length for circumference, it can fit over many different kinds of leads, including multiconductor ribbon cable.

The shield should be firmly grounded to a chassis at both ends. Shielding the cable in this manner changes its characteristic impedance, but in actual operation with three different systems no electrical problems have been encountered. Also, the neat braid-covered wire going to the keyboard and floppy disk drive doesn't detract from the appearance of my computer one bit.

Grounding

Grounding the rf energy, that is, sending it into the earth so that it doesn't radiate through space, is an important step in curing TVI. Your computer is probably grounded electrically through its three-wire plug, but some or all of your peripherals may not be. Either way, the ground path provided through the house wiring is certainly long, circuitous and probably not very effective for rf.

A short, heavy-gauge wire run directly to a metal cold-water pipe may be the solution. If you are blessed with only plastic water pipes, then a ground rod of copper or galvanized pipe driven into the soil at least 4-6 feet might do. The telephone company often connects to a ground somewhere near their entry point. Their connection might give you some ideas.

All of the transformer-powered elements of your computer system should have their chassis connected together by a single direct wire. Braid left over from shielding or braid from the smaller RG-58 type coax is ideal. This separate, direct connection avoids "loops" in the other electrical leads that might trap and radiate rf.

Getting at the "chassis" on some cassette recorders may be tricky. Some units do not use chassis ground as either side of the audio circuit, so simply attaching to the outside jacks will not do. You may have to go in and look for the negative bus on the printed circuit board.

Beware of transformerless TV sets. Don't ever go near those things with any sort of ground lead. Half the time the results are shocking.

Stronger TV Signal

Your computer system should now be holding in all that nasty rf it is generating and sending it off through a ground lead into the earth so that it can't radiate into anyone's TV set. However, there are limits to the effectiveness of even these measures. There is another end to the problem that could use some attention. That is the end at the TV set itself.

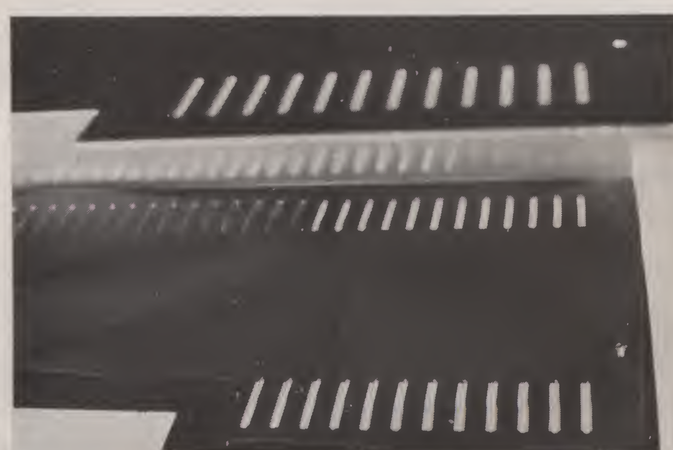
With some types of TVI, traps or filters can be installed at the TV set, which would block out the offending signal. But in this case, the offending signal is at the same frequency as the TV signal we want, so filters on the antenna lead won't work.

The most effective thing that can be done at the TV is to increase the signal-to-interference ratio. The TV station signal is big and powerful compared to the radiations from a microcomputer. The computer is simply closer.

Any improvement that can be made in your TV antenna so that it will deliver more of the desired signal from the TV station will be worthwhile. A stronger TV signal will reduce the automatic gain control in the TV, and the interfering signal may disappear from the set. Get rid of the rabbit ears and install a good outside antenna with some gain and directivity. Check the quality of your lead-in wires and antenna.

Does the lead-in pass just outside the wall where the computer sits? Buy cable TV if you have to, but give the TV station every opportunity to override any residual-radiated signal coming from the computer. The improvement in the TV picture even with the computer off will be worth the investment. ■

Cable shielded with external braid doesn't hurt the looks of this installation.



Copper screening over the vent holes cuts down on the radiation from this cabinet. Additional screw holes were made in the cabinet and front panel to hold the screen in place.

Translating Between TTL and RS-232C Levels

The following article shows how to easily solve the problem of converting TTL-level signals to RS-232C and vice versa. The answer is to use a very low-cost circuit, and here's how.

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When interfacing computer equipment made by various manufacturers, the computerist frequently experiences an annoyance related to the history of computer and communications development: the incompatibility of TTL and RS-232 level signals. The TTL/RS-232C interface problem is often apparent when you attempt to output (or input) serial data to (or from) an RS-232C terminal.

A TTL serial communications signal may originate in several similar ways:

1. TTL data may be loaded into a shift register and stepped out serially.
2. A fancy shift register, such as a UART (universal asynchronous receiver-transmitter), may be loaded with parallel data, which is subsequently transmitted serially.
3. One bit of a parallel output port may be used—in conjunction with software timing loops—to accept or produce serial TTL input/output signals.

The TTL situation occurs with several of the single board microcomputers, such as the SC/MP-II-based Nibbler sold by Digi-Key. In the case of the Nibbler, you simply add a +5 volt power supply and a reset switch to the single board microcomputer to operate with BASIC, *if* your terminal accepts TTL-level signals. However, the list of terminals that do not work with serial TTL I/O signals is extensive and includes the SWTP CT-1024 and CT-64, the Mits Compter and Compter II, etc.

My encounters with the problem have included both cases 2 and 3 described above. In case 2, the goal was to interface an old "surplus" Mits S-I/O B TTL-level serial interface to a CT-1024. Also, I wanted to convert to RS-232C the serial TTL signals on a Mits 88-ACR (audio cassette record interface) to check the tone decoding of the tape interface on-line by simply monitoring the decoded TTL signals with a terminal. In case 3, the level conversion involvement was associated with interfacing a Nibbler to a Diablo (and hiding the microcomputer in the base of the printer).

In the discussion that follows, I describe simple circuits for accomplishing the required conversion.

Circuit Design

There exist integrated circuits that are specifically designed to perform the conversion task. For example, the Motorola MC1488 and MC1489 chip set provides four pairs of such conversion units. However, these chips may not be readily available to the Sunday experimenter and are more expensive (about $2.50 each at the local computer store) than the inexpensive 741 op amp and 7404 hex inverter chips used in the following circuit design.

The conversion to be accomplished is simple. TTL-logic "low" signals must be converted to +12 volts and logic "high" signals to −12 volts. These are not complete signal translator specifications, but they are good enough to work with. The reverse conversion must also be performed.

Fig. 1 shows a simple circuit that converts RS-232C signals to TTL levels. When the input signal is +12 volts, pin 13 of the 7404 inverter is clamped at 5 volts, or a TTL-logic "high" state. Pin 12 then gives the desired TTL output signal. When the input is −12 volts, pin 13 is held at approximately −0.6 volts, giving a TTL-logic "high" state at pin 12, as required.

Two concerns exist with this design. The first concern is with the input line load. The maximum load occurs for a −12 volt signal—6 mA. This is within accepted load limits and can easily drive the input of the 7404 inverter, which demands about 1.6 mA. This current also does not represent much of a heat-dissipation problem for the zener diode—about 2 mW. However, you should remember that zener diodes are not really designed for forwards conduction. However, in this application there is no problem.

The second concern is the zener diode heat dissipation in the +12 volt input mode. In this case the input current is, perhaps, 3 mA with a zener diode reverse conduction voltage drop of 5 volts—.015 Watts. Again, this is no problem.

The second inverter was added as several are available on the 7404 chip, and it was easy

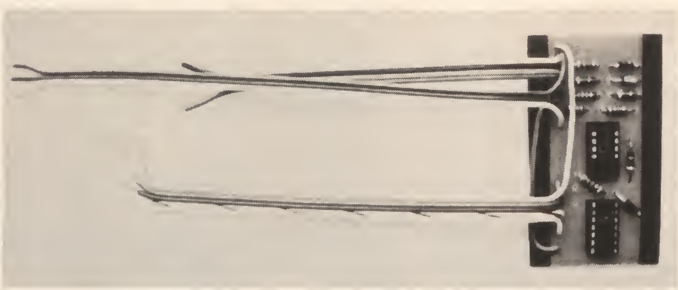

Photo 1. The completed unit. Note that an 8-pin 741 op amp was used.

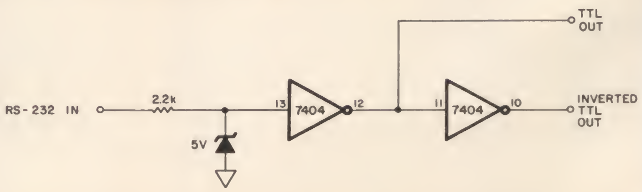

Fig. 1. RS-232C-to-TTL-conversion circuit.

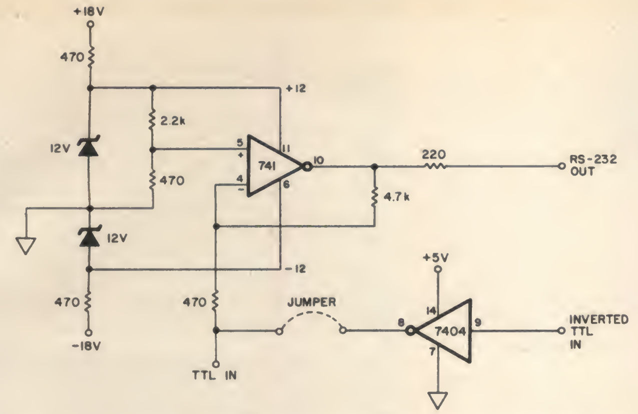

Fig. 2. Circuit to convert TTL-logic level signals to RS-232C.

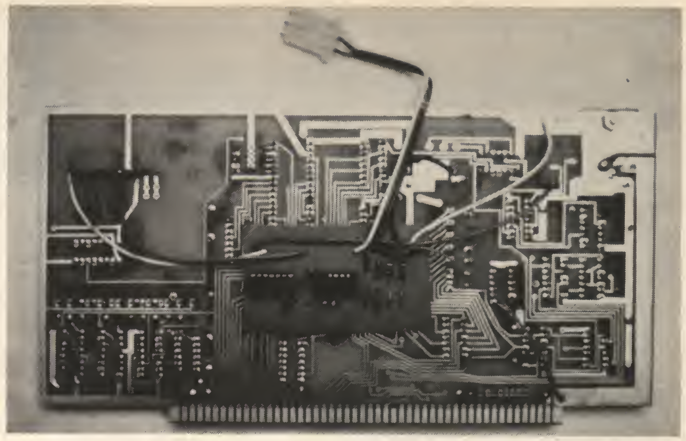

Photo 2. The TTL/RS converter circuit mounted on the back of a Mits S-I/OB serial interface board.

to add the inversion flexibility. The 7404 hex inverter itself was chosen because of its negligible cost and ready availability.

The TTL-to-RS-232C-conversion circuit is shown in Fig. 2. The 741 operational amplifier is used as a comparator. It is powered by a simple ±12 volt supply derived from a zener diode regulation circuit. A voltage divider provides a 2.1 volt reference input to the op amp. This is compared to the input logic level (or its inverse if desired). The amplifier has a gain of ten, a choice that will be explained later.

If a TTL signal of 3.3 volts or more is placed on the negative input of the op amp (pin 4), the output (pin 10) will go to −12 volts, the negative supply limit. If, instead, the input is 0.9 volts or less, the amplifier output will go to the other supply limit, +12 volts. Thus the operation of this circuit is simple; the component value choices are also based on simple considerations.

The operational amplifier feedback level was chosen such that the amplifier would not be heavily driven into saturation. The reason for doing this is to maintain a reasonable amplifier frequency response. For example, if the 741 op amp has a large signal gain × bandwidth product of 1 MHz, with a feedback ratio of 10:1, the amplifier can be used to roughly 100 kHz. Neglecting slew rate limitations (maximum rate of voltage change) and phase problems, we might expect to use such a configuration up to perhaps 30,000 baud. A more likely limit is five to ten kilobaud, which is more than sufficient for most microcomputer applications.

The 741 amplifier is capable of driving a 25 mA load. However, we may expect the RS-232C line load to be more on the order of a few milliamperes. The 220 Ohm output resistor was chosen for circuit protection and is the same value as that found in the Mits S-I/O A RS-232C interface board.

The reference voltage circuit is simply a voltage divider. It draws on the order of 4 mA. Thus the total load on the low-powered ±12 volt supply is less than about 10 mA, including the 1 or 2 mA used by the op amp itself. If the 470 Ohm resistor/12 volt zener circuit is regulating, the current through the resistor will be about 14 mA. Under no-load conditions, this would largely go through the zener diode, and the heat dissipation would be about 150 mW, which is acceptable. Shunting 10 mA to the voltage divider/op amp circuit would still allow regulation.

If more than roughly 8 mA is drawn by the output load, that, plus the voltage divider load and op amp quiescent current, can cause the supply voltage to drop. This serves as further output short-circuit protection. In fact, the circuit in the printed circuit board embodiment has been tested under shorted (to ground) output conditions and appears to be invulnerable.

One final note: The two 470 Ohm resistors connected to the operational amplifier inverting and noninverting inputs were chosen to be equal (design practice is usually to balance the inputs to equalize bias current voltage drops) and consistent with the load/voltage divider configuration.

Printed Circuit Board

A foil etching pattern for the circuits shown in Figs. 1 and 2 is presented in Fig. 3. It is assumed that since TTL signals are to be converted, a +5 volt supply is available.

The final board is small and compact, with the RS-232C and TTL input/output lines grouped together. The component layout is also included on the board itself, simplifying construction.

Observe that a 14-pin DIP pattern is supplied for the 741 operational amplifier. The standard 14-pin 741 DIP will be accommodated by the foil pattern shown in Fig. 3; so will an 8-pin 741 package if it is positioned towards the back end of the hole pattern with pin 1 on the chip placed in hole #3. Fig. 4 shows the pin-out configuration for the two packages. Photo 1 shows a completed TTL/RS-232C converter.

Photo 2 shows a converter board mounted on the back of a

(1) 741 operational amplifier (op amp)
(1) 7404 hex inverter
(1) 220 Ohm resistor
(4) 470 Ohm resistors
(2) 2.2k Ohm resistors
(1) 4.7k Ohm resistor
(1) 5 volt zener diode
(2) 12 volt zener diodes
(1) Printed circuit board

Etched but undrilled printed circuit boards are available from the author for $1.50 each. A kit with all parts is also available for $3.50. Include a self-addressed stamped envelope with your order to ensure rapid delivery.

Table 1.

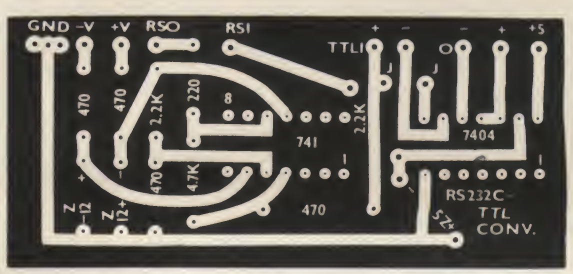

Fig. 3. Foil etching pattern for the circuits shown in Figs. 1 and 2.

Photo 3. *The TTL/RS converter mounted between the two boards that compose the Mits 88-ACR audio cassette recorder interface.*

Mits S-I/OB serial interface. The Mits card produces only TTL I/O signals. The two leftmost wires from the converter are connected to these (TTLI to STSO and TTLO to SRSI). The remaining connections are ground, +5, −18 and +18 volts.

Photo 3 shows a converter used in conjunction with the Mits 88-ACR audio cassette recorder interface. The ACR employs the serial board shown in Photo 2 connected to a modulator/demodulator. The converter is connected as shown in Photo 2, except that a switch is placed between TTLO (converter TTL output) and SRSI (S-I/O board input). When the switch is closed, the terminal (connected to the converter) controls the input to the computer. When open, the modem reigns. Outputs from the computer go to both the modem and converter.

Thus programs can be saved on and loaded from the tape recorder in ASCII form by simply listing and playing back. Files can be easily concatenated. For example, subroutines may be added to a current program by playing them in. Programs recorded over the telephone from a BASIC-speaking computer can also be loaded and then later adjusted to the dialect of the receiving machine. When you perform the latter exercise, remember that long nulls between program statement lines are helpful in avoiding overlaps between those statements and possible error messages.

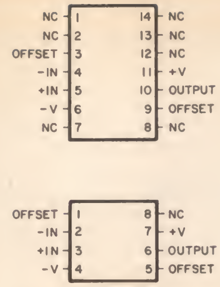

Fig. 4. Pin-out configuration of the 8- and 14-pin 741 operational amplifiers.

By bending out the IC pins on the S-I/OB board, which correspond to the A1 and A2 address line inputs to the SN7430 eight-input NAND gate decoder, and tying those inputs to +5 volts, you can make the 88-ACR respond to all port locations between 000 and 007. This is useful for operating Mits cassette BASIC because it uses ports 000 and 001 for the S-I/OA RS-232 serial interface (which we have duplicated with the addition of the TTL/RS converter to the ACR) communication with the terminal and ports 006 and 007 for the tape recorder. Thus both functions are possible using the modified ACR.

In addition, by connecting SRSI (input to the computer from the modem) to TTLI (TTL input to the converter), you can monitor on the terminal what is being decoded by the modem and adjust the modem accordingly. As many 88-ACR users may agree, this can be a very useful function.

Conclusion

I have used the above circuit design and printed circuit board in several projects with excellent results. Two of the boards were connected back to back (TTL to RS-232/out to RS-232/in to TTL) to determine the maximum baud obtainable with this design. I applied a symmetrical TTL signal to one unit and examined the TTL output of the second unit with an oscilloscope. The TTL output remained symmetrical to 16 kilobaud. At this point, the slew rate limitations of the 741 op amp caused the RS-232 output to become triangular instead of rectangular. To obtain a much healthier RS-232 signal I reduced the baud rate to 10K.

At 16 kilobaud and under these load conditions, the RS-232 signal level was ±10 volts. Shunting this signal line with a 1k Ohm resistor reduced the swing to ±8 volts. Thus, this circuit is capable of providing RS-232C-compatible signals driving a current in excess of 8 mA.

The above tests indicate that the converter should work under most conditions that you might encounter concerning TTL/RS-232 translation. ■

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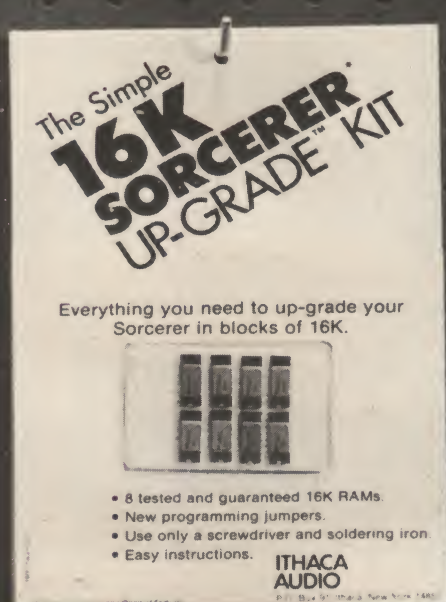

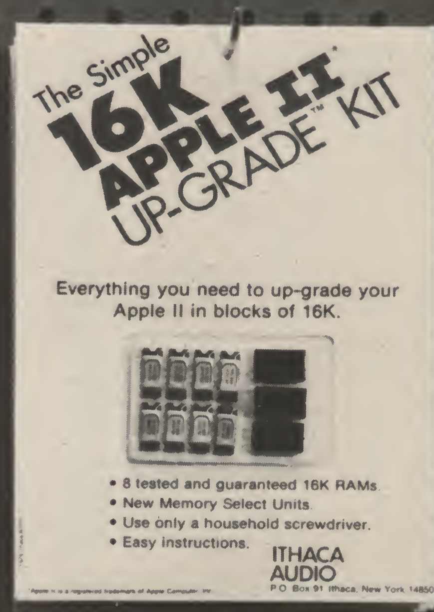

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Data Files for Processor Tech 5K BASIC

What started as a routine project ended up producing a "Frankenstein's monster"!

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The possibilities of this small modification to the PTCO 5K BASIC will amaze you! I started the project to enable me to save the results generated by a BASIC program on something other than paper. It ended up giving me that capability and the ability to create BASIC DATA statements that could be loaded directly into any program plus the fantastic capability to create BASIC programs from a BASIC program. I'm not kidding, it can create its own programs! That means line numbers, statements, variables, etc., are all under program control, without human intervention—unless you want to intrude.

Introduction

My original idea was to take the product of a BASIC program—usually in an array of some kind—and, instead of losing it every time the program terminated, figure out a way to dump the data to cassette tape in a form that I could use as input data for other BASIC programs.

Well, if BASIC has one overriding failing, it is in the area of data handling; I soon realized that the only way to save raw output data in a form that could be used by other programs was to actually create BASIC DATA statements, complete with line numbers, and record them on cassette tape. The only way to do that was to use the PRINT statement to construct a DATA statement and then make the PRINT statements feed the tape recorder, instead of the normal CRT/printer output device.

Once recorded, the DATA statements could be fed into any program by making the computer think that the tape recorder input was the keyboard input. This last step had to be done while the BASIC interpreter was in the command mode (program not running) so that the DATA statements would be added to the program just as if they had been typed in on the keyboard.

I/O Port Switching Subroutines

I needed four assembly-language subroutines to accomplish the I/O port switching required between the regular I/O devices and the cassette I/O. Fig. 1 contains all four subroutines that occupy the area between 1960H and 198BH, 44 bytes total.

Each of the four subroutines is accessed by a BASIC CALL (XXXXX) statement, where XXXXX is the decimal memory location of the subroutine to be called (Table 1). The first subroutine (OUTCS) switches the output port from the CRT/printer to the cassette recorder input. The second subroutine (OUTCR) switches the output port from the cassette recorder input back to the CRT/printer.

These two subroutines enable you to feed all PRINT statements to either the CRT/printer or to the cassette recorder simply by first calling the appropriate subroutine. The power of this capability is not readily apparent, but if you

Routine	CALL Statements	Use
OUTCS	B = CALL (6496)	Changes output from CRT to cassette
OUTCR	B = CALL (6507)	Changes output from cassette to CRT
INCAS	B = CALL (6518)	Changes input from keyboard to cassette
INKBD	B = CALL (6529)	Changes input from cassette to keyboard

Table 1. Subroutine CALL statements.

```
1960            ********************************************************
1960            *  DATA FILE MOD TO PTCO 5K BASIC  VERSION 1.0 12 OCT 78*
1960            ********************************************************
1960            *
1960            * CHANGE OUTPUT FROM CRT TO CASSETTE
1960            *
1960 21 E7 0F   OUTCS  LXI   H,0FE7H   LOAD ADDRESS OF STATUS BYTE
1963 36 08             MVI   M,08H     MOVE NEW STATUS MASK TO LOC
1965 21 ED 0F          LXI   H,0FEDH   LOAD ADDRESS OF DATA PORT
1968 36 02             MVI   M,02H     MOVE CASSETTE PORT NUMBER TO I/O ROUTINE
196A C9                RET
196B            *
196B            * CHANGE OUTPUT FROM CASSETTE TO CRT
196B            *
196B 21 E7 0F   OUTCR  LXI   H,0FE7H
196E 36 02             MVI   M,02H
1970 21 ED 0F          LXI   H,0FEDH
1973 36 01             MVI   M,01H
1975 C9                RET
1976            *
1976            * CHANGES INPUT FROM KBD TO CASSETTE
1976            *
1976 21 93 0E   INCAS  LXI   H,0E93H
1979 36 04             MVI   M,04H
197B 21 3E 0E          LXI   H,0E3EH
197E 36 02             MVI   M,02H
1980 C9                RET
1981            *
1981            * CHANGES INPUT FROM CASSETTE TO KBD
1981 21 93 0E   INKBD  LXI   H,0E93H
1984 36 01             MVI   M,01H
1986 21 3E 0E          LXI   H,0E3EH
1989 36 01             MVI   M,01H
198B C9                RET

SYMBOL TABLE

INCAS 1976   INKBD 1981   OUTCR 196B   OUTCS 1960
```

Fig. 1. I/O port switching subroutines.

think about it, the PRINT statement can produce just about any combination of constants, variables, quoted strings, statements, etc., that you might want.

Fig. 2 is an example of a PRINT statement that produces a DATA statement. This PRINT statement sends only the portion within the quote marks "" to the cassette recorder (1000 DATA 45,68,39,22 CR LF).

The carriage return (CR) and line feed (LF) are generated by the program at the end of a PRINT statement and are sent to the tape recorder. When fed back from the tape recorder to the computer while the BASIC interpreter is in the command mode, this line will load itself in as a DATA statement and will become line 1000 in whatever program resides in the BASIC interpreter.

The third subroutine (INCAS) switches the input port from the keyboard to the cassette recorder output, allowing the DATA statements to load themselves. The fourth subroutine (INKBD) switches the input port back to the keyboard from the cassette recorder output. With these two subroutines you will be able to take the recorded DATA statements and load them directly into a program and then return input control to the keyboard.

```
LIST
64500 REM   VARIABLES TO BE INSERTED INTO DATA STATEMENTS MUST
64510 REM   BE LOCATED IN THE "V" ARRAY AND THAT ARRAY MUST BE
64520 REM   DIMENSIONED ACCORDINGLY!!!!!!!!!!!!!!!!!
64530 REM **************TEST DATA LOADER************************
64540 DIM V(100)
64550 FOR A=1 TO 100
64560 V(A)=RND(T)
64570 NEXT A
64580 REM ************END OF TEST DATA LOADER*****************
64590 PRINT
64600 REM ******* DATA STATEMENT CONSTRUCTOR *******
64610 PRINT"INPUT NUMBER OF DATA STATEMENTS: ",;INPUT,X
64620 PRINT"INPUT NUMBER OF DATA ELEMENTS IN EACH STATEMENT: ",;INPUT,Y
64630 PRINT"INPUT STARTING LINE NUMBER: ",;INPUT,L
64640 PRINT"INPUT LINE NUMBER INTERVAL: ",;INPUT,P
64645 B=CALL (6496)
64650 FOR I=1 TO X
64660 L1=L+(I*P)
64670 PRINTL1,"DATA ",
64680 FOR J=1 TO Y
64690 K=I*J
64700 IF J=Y THEN PRINTV(K),
64705 IF J<>Y THEN PRINTV(K),",",
64710 NEXT J
64720 PRINT
64730 NEXT I
64740 PRINT"          B=CALL (6529)"
64750 B=CALL (6507)
64760 PRINT"DONE-CONTROL RETURNED TO KBD/CRT"
64999 END
```

Fig. 3a. DATA statement constructor.

100 PRINT "1000 DATA 45,68,39,22"
RESULTS IN
1000 DATA 45,68,39,22

Fig. 2. Conversion of a PRINT statement to a DATA statement.

PRINT-to-DATA-Statements Conversion

By inserting variables in the PRINT statements I found that I could automatically assign line numbers and pluck data from anywhere in the data base in exactly the formats I needed. Fig. 3 is an example of a complex DATA statement constructor where even the number of data elements in the DATA statement is a variable. Inserting this constructor at the end of a BASIC program and aligning its variables with those that you wish to save will allow you to create any number of DATA statements with a variable number of elements all under software control.

Once you have recorded all of your DATA statements, load the program that will use the DATA statements, type in the single CALL statement in Fig. 4, start the recorder and hit the return key. Your DATA statements will load themselves just as though you were typing them in from the keyboard yourself. By always making the last statement inserted by the constructor the CALL statement in Fig. 5, you will ensure that control is returned to the keyboard after the last DATA statement is loaded. The assembly-language subroutines that do all of the switching (Fig. 1) are structured for my I/O scheme, so the port numbers and masks will need to be changed to reflect your I/O scheme.

A Frankenstein

At this point I had satisfied my original goal of saving and reusing data bases without having to type them in myself, but I soon became aware that if I could create DATA statements under software control, I could create any BASIC statement under software control. Thus I could use my computer to create BASIC programs!

This stark realization scared me because it would allow the computer to alter its own algorithms as a result of experience and simulate the learning process. Simple experiments indicate that any of the BASIC statements can be constructed in the same manner as I have constructed the DATA statements, and, indeed, whole programs can be constructed. Programmers beware: This thing could take over all software development!

At this point I will bow out and let your imagination run wild as mine has. I will probably be working on a universal program generator for the rest of my life, and I figured if I could get this published there would be a bunch of other fools right in there with me. Lots of luck!

Restrictions

This project has met all of the goals I set, but it does have one quirk that I must warn you about. The speed at which your computer can handle the tape input is limited by the speed of the output device to which that input is echoed. When a keyboard is used as an input device the speed usually does not matter, but when the charac-

```
INPUT NUMBER OF DATA STATEMENTS: 10
INPUT NUMBER OF DATA ELEMENTS IN EACH STATEMENT: 5
INPUT STARTING LINE NUMBER: 2000
INPUT LINE NUMBER INTERVAL: 500
 2500 DATA  .361117 , .040513 , .413016 , .058217 , .892233
 3000 DATA  .040513 , .058217 , .608079 , .264695 , .28444
 3500 DATA  .413016 , .608079 , .06347 , .116282 , .056439
 4000 DATA  .058217 , .264695 , .116282 , .853631 , .93187
 4500 DATA  .892233 , .28444 , .056439 , .93187 , .050816
 5000 DATA  .608079 , .116282 , .459175 , .400634 , .06051
 5500 DATA  .976036 , .197627 , .838286 , .288647 , .524859
 6000 DATA  .264695 , .853631 , .400634 , .777737 , .483325
 6500 DATA  .06347 , .459175 , .687667 , .547727 , .373242
 7000 DATA  .28444 , .93187 , .06051 , .483325 , .658397
       B=CALL (6529)
DONE-CONTROL RETURNED TO KBD/CRT
```

Fig. 3b. Program run results with line 64645 deleted (output is sent to CRT instead of cassette).

```
LIST
2500 DATA  .383522 , .708914 , .25595 , .510465 , .057526
3000 DATA  .708914 , .510465 , .092433 , .244519 , .340362
3500 DATA  .25595 , .092433 , .789559 , .177034 , .716639
4000 DATA  .510465 , .244519 , .177034 , .357151 , .120418
4500 DATA  .057526 , .340362 , .716639 , .120418 , .142469
5000 DATA  .092433 , .177034 , .110157 , .831519 , .96294
5500 DATA  .438685 , .630211 , .500514 , .048621 , .031472
6000 DATA  .244519 , .357151 , .831519 , .619452 , .889222
6500 DATA  .789559 , .110157 , .458788 , .048799 , .05362
7000 DATA  .340362 , .120418 , .96294 , .889222 , .903577
64500 REM   VARIABLES TO BE INSERTED INTO DATA STATEMENTS MUST
64510 REM   BE LOCATED IN THE "V" ARRAY AND THAT ARRAY MUST BE
64520 REM   DIMENSIONED ACCORDINGLY!!!!!!!!!!!!!!!!!!
64530 REM *************TEST DATA LOADER************************
64540 DIM V(100)
64550 FOR A=1 TO 100
64560 V(A)=RND(T)
64570 NEXT A
64580 REM ***********END OF TEST DATA LOADER*****************
64590 PRINT
64600 REM ******* DATA STATEMENT CONSTRUCTOR *******
64610 PRINT"INPUT NUMBER OF DATA STATEMENTS: ",!INPUT,X
64620 PRINT"INPUT NUMBER OF DATA ELEMENTS IN EACH STATEMENT: ",!INPUT,Y
64630 PRINT"INPUT STARTING LINE NUMBER: ",!INPUT,L
64640 PRINT"INPUT LINE NUMBER INTERVAL: ",!INPUT,P
64645 B=CALL (6496)
64650 FOR I=1 TO X
64660 L1=L+(I*P)
64670 PRINTL1,"DATA ",
64680 FOR J=1 TO Y
64690 K=I*J
64700 IF J=Y THEN PRINTV(K),
64705 IF J<>Y THEN PRINTV(K),",",
64710 NEXT J
64720 PRINT
64730 NEXT I
64740 PRINT"          B=CALL (6529)"
64750 B=CALL (6507)
64760 PRINT"DONE-CONTROL RETURNED TO KBD/CRT"
64999 END
```

Fig. 3c. DATA statement constructor with the data it generated loaded back into it.

```
B = CALL (6518)
```

Fig. 4. Cassette input CALL statement.

```
B = CALL (6529)
```

Fig. 5. Keyboard input CALL statement.

ters are coming in at 300 baud plus, it does matter. The most critical limitation is the time it takes the output device to process a carriage return.

Processor Technology 5K BASIC has a NULL XXX command that transmits XXX null characters after each carriage return, thus setting up a period of time to allow for carriage-return processing. In the case of my TVT-II, the NULL must be set to at least 12 or the data will overrun the carriage-return processing. Overrun will cause some of the DATA statements to be missing and will probably leave the input port connected to the cassette recorder instead of switching it back to the keyboard.

There are two ways to cure this last affliction: reload BASIC or have a cassette on hand with the recovery CALL statement on it (B = CALL (6507)) by itself. If you have a low- or medium-speed printer as your echo device, you will have to set the NULL relatively high (40 or so to prevent overrun). Higher NULL settings are required for cassette interfaces operating above 300 baud also.

Remember: If the null is not set right in both the original program and the one to which the data is to be loaded, you may hang up in the cassette mode with bad data in the data base.

Technical Details

The assembly-language subroutines are loaded just above where PTCO 5K BASIC now stops, and it does alter the minimum starting location in the preamble questions when BASIC is initialized. FIRST ADDRESS should be at least 6550 (I use 6600 to be safe). Make sure to insert the NULL command to prevent carriage-return overrun. Be certain that the last statement loaded on every tape is B = CALL (6507) to ensure that control is returned to the keyboard after a data load. ■

✓ Reader Service—see page 179

Reader Service—see page 179

Little Bits

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Number Conversion

This routine asks for a decimal number between 1 and 225 and then prints the hex and octal equivalents. If a zero is entered, control reverts to BASIC. It is written in Processor Technology's Extended BASIC, which does not allow string arrays. If your BASIC does, then replace lines 20 and 80 with the statements contained in the remarks from 190 to 240.

```
 10 REM-DECIMAL TO HEX AND OCTAL ROD HALLEN  21 JUNE 78
 20 DIM A$(16): LET A$="0123456789ABCDEF"
 30 FOR I=1 TO 255
 40   INPUT ,"DECIMAL NUMBER ? ",N
 50   IF N=0 THEN 150
 60   LET X=INT(N/16)
 70   LET X1=N-X*16
 80   PRINT "  HEX  ";A$(X+1,X+1);A$(X1+1,X1+1),
 90   LET Y=INT(N/64)
100   LET Y1=INT((N-(Y*64))/8)
110   LET Y2=N-((Y*64)+(Y1*8))
120   PRINT "OCTAL  ";Y;Y1;Y2
130   PRINT
140 NEXT I
150 END
180 REM-CHANGES FOR STRING ARRAYS
190 REM-20 DIM A$(16)
200 REM-21 FOR J=1 TO 16
210 REM-22 READ A$(J)
220 REM-23 NEXT J
230 REM-24 DATA 0,1,2,3,4,5,6,7,8,9,A,B,C,D,E,F
240 REM-80 PRINT "  HEX  ";A$(X+1);A$(X1+1),
```

Program listing.

```
            Assumes character in R0
1.  UC    CI    R0,060   Lowercase?
2.        JL    UC1      No. Don't translate
3.        CI    R0,07F   Is it a rub-out?
4.        JEQ   UC1      Yes. Leave it alone
5.        ANDI  R0,05F   No. convert to uppercase
6.  UC1   RT             Return to caller
```

Fig. 1. Lowercase-to-uppercase-conversion subroutine for the TMS 9900.

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Easy Lowercase

At long last we can purchase low-cost computer peripherals that work in both uppercase and lowercase; yet virtually every keyboard I see is locked to use uppercase letters only. Why? It seems that in every system there is at least one piece of software that doesn't recognize lowercase letters. Lowercase so improves readability that we shouldn't give it up so willingly[1], especially since it's so easy to write a program that accepts both uppercase and lowercase. Here's how:

1. Write your program assuming the text it receives is all uppercase.
2. In your common-character load subroutine (you *did* use one, didn't you?), insert a translate to uppercase.

This will allow you to enter data in either uppercase or lowercase and still allow your program to recognize its keywords, commands or whatever. When your program stores text in memory, it should be stored as entered and retranslated each time the program looks at it. This allows it to be printed back as it was entered, not in (yukkk) ALL CAPS. Writing a subroutine to do the conversion from lowercase to uppercase is as easy as the two steps given above (see Figs. 1 and 2).

These subroutines leave the rub-out character (7F hex) unchanged. If you don't mind having rub-out changed to "_", you can delete lines 3 and 4 in both subroutines. It is usually easy to patch these routines into existing programs to make them case-insensitive, but it would be far better if vendors did this before they distributed their software. It's really very little trouble, and it does make things much nicer. Please?

[1]Bill McLaughlin, "ALL CAPS should be laid to rest," *Kilobaud*, December 1977, p. 60.

```
        ;
        ;       Assume character in Accumulator
        ;
1.      UC:     CPI     60H     Is character lowercase?
2.              RC      .       No. Return
3.              CPI     7FH     Yes. It is rub-out?
4.              RZ      .       Yes. Leave it alone
5.              ANI     5FH     No. Translate to uppercase
6.              RET     .       Return to caller
```

Fig. 2. Lowercase-to-uppercase-conversion subroutine for the 8080 or Z-80.

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A "Sneaky Interrupt" for the 6502

Looking for a way to interrupt your 6502 other than through NMI or IRQ? If you use a 6502 microprocessor and need an additional method of getting your computer's attention, then read on.

About three years ago I wanted to learn more about digital electronics. What better way than to build my own microcomputer? But before I could begin I had to do a lot of investigating to determine what type of processor to use.

After much agonizing I settled on the 6502 since it seemed to be much more concise than the 8080 and, to me, was easier to program than either the 8080 or 6800. After all I have subsequently learned, I'm glad I made this choice. I feel there is no better microprocessor on the market than the 6502 (that ought to stir up all the 8080 people out there).

During the process of working up my system, I needed some way to get information to my processor other than through the normal NMI or IRQ interrupt methods. NMI was dedicated to the reset and stop functions, and IRQ was being used for a particular application.

The normal method of solving this problem would have been to set up a system of polled or priority interrupts. This seemed like a lot of work for only one additional requirement, so I began the search for an easier and simpler way. That's when I discovered the 6502 "sneaky interrupt."

The 6502 sneaky interrupt can be found hiding on the S0 input pin. This is an input that sets the overflow flag in the processor whenever it detects a transition from high to low. The edge sensitive nature of this input makes it convenient and easy to use. All you have to do is provide this edge and software to interrogate the V flag periodically to detect an interrupt request.

Of course, if your program is performing arithmetic operations such as ADC, SBC or BIT instructions, you must be careful that no conflicts in the use of the overflow flag are created. In my experience so far, this has never been a problem.

I currently use this method to detect a keyboard input to my BASIC interpreter. When BASIC is ready for some input, it executes a JSR to a routine called KEYIN. If you are concerned about the previous status of the V flag, you can preserve it by pushing the status register onto the stack before the CLV and pulling it back before the RTS.

This method requires very little hardware (none in my case since S0 is tied to the keyboard strobe) and a minimum of software.

```
KEYIN   CLV           clear the V flag
        NOP           wait
        BVC-1         if V is not set, go back to wait
        JSR GETKEY    if V is set, go to GETKEY routine
        RTS
```

KEYIN routine.

E. M. McCormick
13100 Chapman, Apt. 3-113
Garden Grove CA 92640

Calculating Pi . . . The Leibnitz Method

Calculating the value of pi (3.14159 . . .) is a way of testing and comparing the number-crunching capabilities of various micros. It produces a familiar number, although most people will remember only the first few digits in the series.

The easiest method of computing pi uses this series discovered by Leibnitz in 1694:

$$\text{pi} = 4\left(\frac{1}{1} - \frac{1}{3} + \frac{1}{5} - \frac{1}{7} + \frac{1}{9} - \frac{1}{11} + \cdots\right)$$

Although it is simple to program, this series requires many thousands of terms for even a few places of accuracy. However, it is easy to extend it so that it converges quite rapidly. The program listing shows the BASIC program to do this.

This program calculates pairs of terms in the series. Value S# (line 50) will fluctuate around pi/4. However, P# (line 60) makes two corrections to S#. First, by adding 2*M#, it calculates a value midway between that of the two terms. Since the value of the denominator is ever-increasing, this midpoint correction actually overcorrects. The final term, −2*M#↑2, compensates for this overcorrection.

A Level II TRS-80 will calculate pi to ten places in 37 seconds and to 13 places in eight minutes when using this program. Incidentally, the correct value to 15 places is 3.141592653589793.

Richard Wright
676 Coe Rd.
Tiffin OH 44883

MIKBUG Load . . . Show and Tell

Loading long programs from tape using the MIKBUG "L" function can be nerve-racking due to the lack of output to the terminal. You can overcome this problem by loading E013 at A048 and A049 and entering "G" instead of "L." Your program will now display on your terminal as it loads into memory.

```
10 REM PI CALCULATION, E. M. MC CORMICK, 8-11-78
20 S#=0
30 X#=1
40 M#=1/(X#+2)
50 S#=1/X#-M#+S#
60 P#=4*S#+2*M#-2*M#↑2
70 PRINT X#,P#
80 X#=X#+4
90 GOTO 40
100 END
```

Program listing. Rapid calculation of pi using Leibnitz' series.

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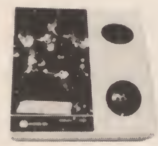

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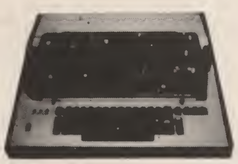

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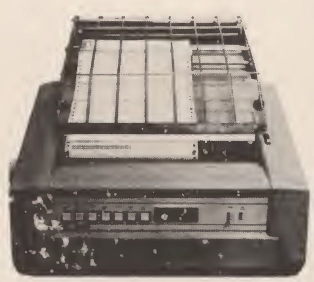

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Reader Service—see page 179

This questionnaire is very important

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D. Other

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Other ________

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C. Altair
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E. Compucolor
F. Cromemco
G. Data General
H. Elf (Quest)
I. Elf (Netronics)
J. Exidy Sorcerer
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Y. TRS-80 Level II
Z. Vector Graphic
AA. VIP (RCA)
BB. Wave Mate
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DD. S-100 Homebrew
EE. Other ________

6) How much RAM does your largest system contain?
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B. 4K-7K
C. 8K-11K
D. 12K-15K
E. 16K-23K
F. 24K-31K
G. 32K or more

7) How much have you invested in your microcomputer systems?
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B. $500-1,000
C. $1,000-1,500
D. $1,500-2,000
E. $2,000-3,000
F. more than $3,000

8) How much will you spend on your system this year?
A. Less than $500
B. $500-$1,000
C. $1,000-1,500
D. $1,500-2,000
E. $2,000-3,000
F. more than $3,000

9) Do you program mostly in:
A. BASIC
B. FORTRAN
C. Assembly language
D. Machine language
Other ________

10) Which of the following do you own?
A. Printer
B. Modem
C. Word Processor
D. Mini-floppy
E. 8-inch floppy
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11) Where do you get most of your software?
A. Write it myself
B. Magazines
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12) I read the following magazines:
A. Kilobaud/Microcomputing
B. Interface Age
C. Byte
D. Computerworld
E. Personal Computing
F. Creative Computing
G. Popular Electronics
H. Radio Electronics
Others ________

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C. Byte
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E. Personal Computing
F. Creative Computing
G. Popular Electronics
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L. Club Calendar
M. BASIC Forum

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B. Construction of major equipment
C. Construction of accessories and gadgets
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G. Operating systems and monitors
H. Techniques of programming
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Other ________

17) Are most of the articles:
A. Too complex?
B. Too simple?
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18) What kinds of general interest articles do you like?
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What's so Magic about the Sorcerer?

It's no secret, but you have to read this article to find out.

You don't have to follow the yellow brick road to its end to find the Sorcerer of Exidy (Exidy, Inc., Data Products Division, 969 West Maude Ave., Sunnyvale CA 94086). He is probably in your friendly neighborhood computer store right now. But just in case you haven't yet seen this fabulous machine, let's take a quick look at the Sorcerer's array of special features and then spend some time investigating just how to use them.

The Sorcerer computer arrived on the personal-computer scene in the fall of 1978, somewhat later than its competitors. As delivered at $895 in the 8K byte RAM version, the Sorcerer does not include all the items shown in Photo 1. As a matter of fact, the basic machine doesn't even include a CRT monitor or a cassette tape deck, both of which are indispensable for its operation as a home/personal/hobbyist computer.

Adding the cost of these "options" increases the price of the Exidy machine to more than just above that of the competition. So how can you justify the higher expenditure for the Sorcerer? The special features of this computer have to provide the justification.

What Makes It Special

The minimum memory configuration of the computer includes 8K bytes of RAM, and, after the on-board monitor and ROM-PAC BASIC grab their stack and work space, 7400 bytes of program space are still available to the BASIC language programmer. RAM can later be expanded on-board to 16K or 32K bytes, or you can purchase the machine in these larger configurations if you know how much memory you are going to need ahead of time.

The microprocessor is the Z-80 running with a 2 MHz clock, and Table 1 shows how fast it executes the *Kilobaud* benchmarks (see "BASIC Timing Comparisons" articles in the June 1977 (p. 66) and October 1977 (p. 20) *Kilobauds*). The Z-80 CPU should enable the Sorcerer to run circles around the Altair, so the results of the benchmark programs are a little disappointing, as well as confusing.

Photo 1. The Sorcerer computer with up to 32K bytes of RAM is contained completely within the keyboard housing, requiring only the addition of a CRT monitor and cassette tape deck. BASIC language in ROM is supplied in the cartridge plugged into the right side of the machine. (Photos courtesy of Exidy, Inc.)

Memory size and speed, however, are not the true measures of the value of this computer. Its built-in features not found on any other machine in its price range make this computer a first choice for the more serious user. The Sorcerer comes complete with:

- An instantly replaceable ROM-PAC cartridge (EPROM-PAC optional) allowing sudden swapping of programming languages or application programs.
- Complete interfaces for *two* cassette tape drives, including motor on-off controls and selectable 300 bps Kansas City Standard or 1200 bps Exidy format recording.
- Eight-bit-wide parallel input and output ports with handshaking controls accessible through a standard DB-25S

connector on the back panel.

- An additional 50-pin card edge connector interfacing with the Z-80 CPU, which can be used to attach an S-100 bus-compatible expansion chassis.
- An RS-232 serial I/O port with selectable 300 or 1200 baud rates.
- Uppercase and lowercase ASCII capability of both the keyboard and the 64 character by 30 line display.
- Built-in graphics characters and user-programmable graphics characters, both of which can be accessed from the keyboard or displayed by BASIC or machine-language programs.
- A complete 4K monitor program that includes I/O driver routines used by BASIC, which could also be called by machine-language user programs.

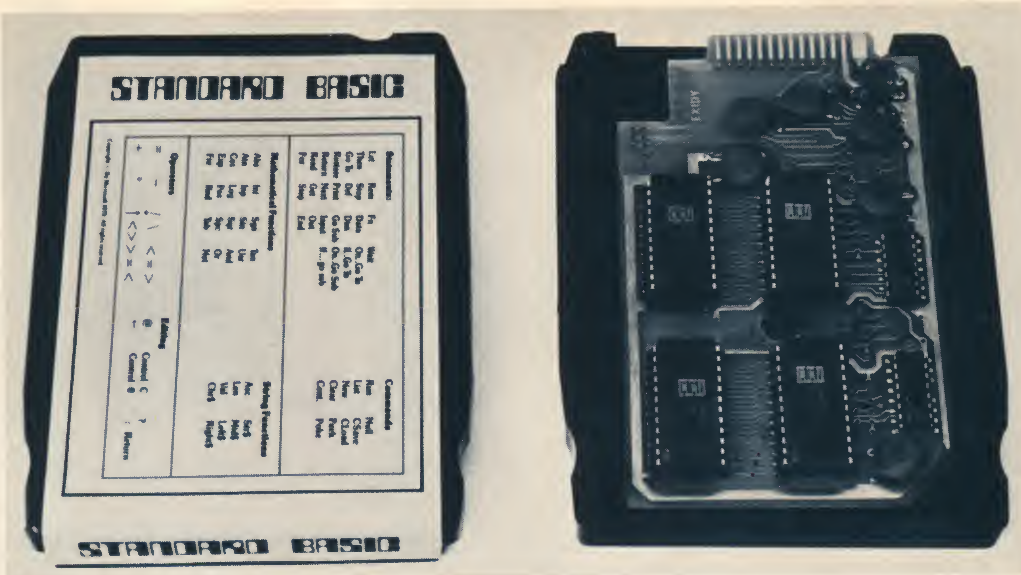


Photo 2. The ROM-PAC has been opened up, showing the four ICs containing an 8K version of Microsoft BASIC. The same package can be configured for the more popular EPROMs, permitting the user to change to an instantly loadable application program.

Using the Special Features

Without having to purchase the S-100 expansion unit, you can configure a real data-processing system with the Sorcerer. For example, in a small-business environment that requires processing account records and preparing statements, you could read in last month's data (one account at a time) from cassette #1. You could then key in the current month's activity. Updated account records could be written out on cassette #2; statements could be generated on a line printer interfaced to the parallel output port; and updated data could then be relayed to the home office through a modem connected to the RS-232 port, while date and time of day could be input from a digital clock through the parallel input port!

Of course, this scenario requires the purchase of the clock, modem, printer, tape decks and CRT monitor—as well as some interfacing and lots of software—but it does illustrate the immense capability of the basic machine.

These features make the Sorcerer a wise choice for the serious user of a small computer, while the experimenter can interface the computer to all sorts of external devices without jeopardizing the integrity (or warranty) of the hardware.

With the latter type of use in mind, let's take a look at a couple of the features of the Sorcerer and see how easy it is to make use of them. We will be examining one user's experiences with the EPROM-PAC and the parallel I/O port, and you can profit from the solutions to the minor problems he encountered.

ROMs and EPROMs

Photo 2 shows an opened-up ROM-PAC supplied with the Sorcerer. This PAC contains an 8K version of Microsoft BASIC language in the four ROMs. These ICs are pin compatible with 2716-type EPROMs, so the same cartridge is supplied (with a different label and no ROMs) as an optional EPROM-PAC. This allows the user with a suitable programmer to insert his own machine-language application program.

Included with the EPROM-PAC are instructions showing how you can change jumpers on the PAC's printed circuit board to alternately accommodate either 2708 or 2732 EPROMs. Currently, 2708s are the most cost-effective EPROMs for the small-quantity user, but they restrict the PAC capacity to 4K bytes. The user of 2716s can load up to 8K bytes, while a real high roller with a fat wallet can program 16K bytes into four 2732s.

In addition to this plug-in cartridge carrying either ROMs or EPROMs, the Sorcerer includes an on-board monitor program in ROM. If no PAC is inserted into the machine at power-up time, the monitor will initialize the computer, clear the display screen, home the cursor and display a message announcing its presence and how much RAM is available. You can then use the monitor to load machine-language programs from tape, examine or alter memory locations, reassign I/O devices, etc.

Provided that a ROM- or EPROM-PAC has been inserted into the computer before power up, however, the monitor program will initialize things and then jump to a starting address at the top of the PAC's address space. This feature enables a user's EPROM-resident appli-

Software; Hardware	CPU	Benchmark Number						
	Type	1	2	3	4	5	6	7
Microsoft Standard BASIC; Exidy Sorcerer	Z-80	1.9	10.2	21.4	22.5	24.6	38.0	54.3
Altair 12K Extended BASIC; Altair 8800b	8080A	1.9	7.5	20.6	20.9	22.1	37.0	58.5
Microsoft 12K Extended BASIC; MSC 8080 +	8080	2.1	10.0	24.2	25.1	27.8	43.0	67.4
Microsoft 12K Extended BASIC; Intel MDS-800	8080A	6.2	17.0	34.5	36.8	46.1	87.4	130.9

Table 1. Benchmark timings (in seconds). The Sorcerer runs neck and neck with an Altair (as reported in the October 1977 Kilobaud, *p. 20). Two development systems not previously timed are included for reference. The Intel system has a complicated bus control logic that may be inadvertently hung up in a cycle-stealing mode. The MSC 8080 + is from Monolithic Systems Corp., Englewood CO, and uses an old, "slow" 8080.*

```
DU D000 D0FF

ADDR   0  1  2  3   4  5  6  7   8  9  A  B   C  D  E  F

D000:  21 20 D0 7E  FE FF CA 03  E0 CD 1B E0  23 C3 03 D0
D010:  FF FF FF FF  FF FF FF FF  FF FF FF FF  FF FF FF FF
D020:  0D 0A 45 58  49 44 59 20  53 4F 52 43  45 52 20 45
D030:  50 52 4F 4D  20 50 41 43  20 54 45 53  54 20 56 20
D040:  37 38 2E 31  20 20 20 20  20 20 0D 0A  0A 43 4F 50
D050:  59 52 49 47  48 54 20 28  43 29 20 31  39 37 38 20
D060:  42 59 20 42  4F 52 52 45  47 4F 20 45  4E 47 49 4E
D070:  45 45 52 49  4E 47 20 20  20 20 20 0D  0A 0A 20 20
D080:  20 20 20 41  20 4C 69 74  74 6C 65 20  53 74 6F 72
D090:  79 20 20 20  20 20 0D 0A  0A 20 20 4F  6E 63 65 20
D0A0:  75 70 6F 6E  20 61 74 69  6D 65 20 74  68 65 72 65
D0B0:  20 77 65 72  65 20 74 77  6F 20 6C 69  74 74 6C 65
D0C0:  20 43 6F 6D  70 75 74 65  72 73 2E 20  20 20 0D 0A
D0D0:  4E 4F 57 20  6C 6F 6F 6B  20 61 74 20  74 68 65 20
D0E0:  6D 65 73 73  20 77 65 27  72 65 20 69  6E 21 21 20
D0F0:  0D 0A 0A FF  FF FF FF FF  FF FF FF FF  FF FF FF FF
```

Fig. 1. Sorcerer's built-in monitor program has been called upon to "dump" the contents of the first 256 bytes of a user program in a 2708 EPROM. The monitor can be directed to write onto the CRT screen, or to a printer connected to the parallel output port, as in this example.

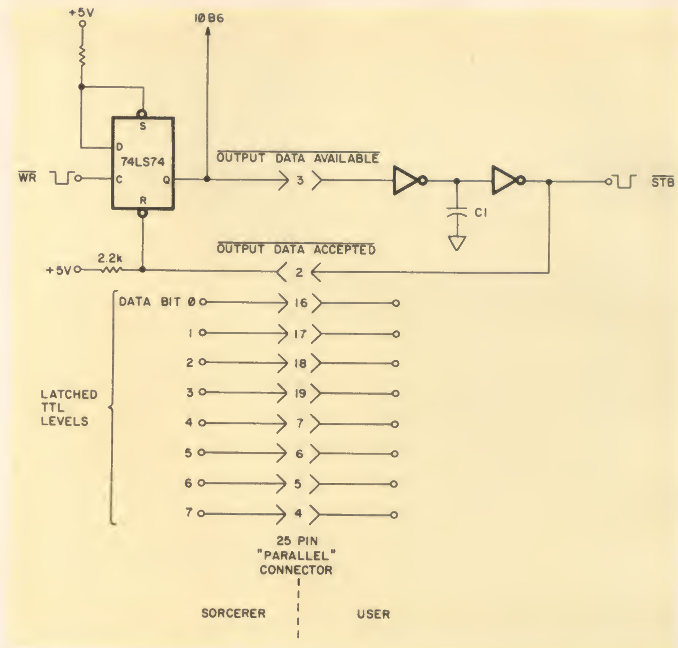


Fig. 3. A partial schematic of the parallel port circuitry. Following a write to the output port (address 0FF, 255 in decimal) the handshake flip-flop presents a low level to the data-available line. The user's interface hardware must return a data-accepted strobe. The circuit shown on the right can be used to perform this function. Status of the handshake flip-flops is sensed through input port 0FE(254).

cation program to continue operation following a power interruption. The Sorcerer can therefore be readily configured as a stand-alone no-operator-needed dedicated controller.

This was one of the features of this computer that I found absolutely irresistible, since I've been designing control systems for over a decade. This same feature is used to initiate BASIC, if that ROM-PAC is inserted, so that the user of the higher-level language need never know that the monitor program exists, even though it is handling all his input and output operations for him. This is *real* flexibility!

My Sorcerer arrived a few weeks before my EPROM-PACs did, so I had time to dream up lots of nice applications for this instant-on feature. For a quick check I programmed the low-order 256 bytes of a 2708 with the code show in Fig. 1. (This memory dump was printed by the monitor on an ASR-33 Teletype interfaced through the parallel outport—more details later!) Jumpering the EPROM-PAC in accordance with Exidy's instructions for the 2708, I inserted the 2708 into the proper socket. I impatiently fired up the computer and looked for the proper display on the CRT. It wasn't there! The monitor announced that it was in operation, but my PAC program was nowhere to be found.

Using the memory dump facility of the monitor, which can be slowed down to a comfortable speed, I searched the entire memory address space for my EPROM program. It was not to be found.

Much research time later I had discovered that, of the 20 jumpers needed in groups 1 through 4 on the EPROM-PAC circuit board to configure it for 2708s, the data sheet had omitted seven! Fig. 2 shows *all* of the jumpers in these four groups which are needed for 2708s. I haven't yet had occasion to debug the documentation provided for the other chip types, but this drawing should save you 2708 users much grief.

With the proper jumpers in place, the program as listed ran just fine. I'll leave it to the dedicated reader to discover what the screen displayed.

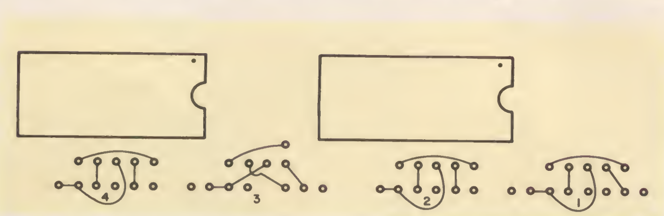


Fig. 2. A partial view of the jumpers required to configure the EPROM-PAC for 2708s. Seven of the 20 jumpers shown in groups 1 through 4 were missing from the original documentation.

Parallel Port Principles

Even though the manufacturers of hand-held calculators have managed to solve the problem, to date there are no less-than-a-kilobuck computers with a built-in printer. Anyone who does more than just play space war games knows that the most desirable peripheral to add to the basic computer is a hard-copy device. The realization may come in minutes, or it may take days before the lack of hard copy becomes painfully apparent. But the pain is inevitable.

The Exidy Sorcerer is ready to have a Centronics printer attached to its parallel output port. The monitor is set up to enable the operator to assign the parallel output port as the output device in place of the CRT display. Handshaking signals ("output data available" and "output data accepted") are included in the interface, compatible with this printer.

What might not be so compatible with every user of the Sorcerer is the price of a Centronics printer. In the event that you are like me and want to hang some other device(s) on the parallel input and output ports, you need a working knowledge of the hardware and software requirements. Let's examine the output port first, since it is the most likely to be used first.

The user's manual supplied with the computer is scanty on specific details concerning these ports. As of this writing the hardware reference manual is not yet in print, but Exidy was kind enough to supply me a set of schematics, allowing me to provide the following details.

A simplified diagram of the handshake hardware for the output port is shown on the left half of Fig. 3. When a byte of data is to be transmitted through this port, an internal write strobe ($\overline{WR}$) causes the eight data bits to be latched into an octal latch. As far as the outside world is concerned, it is only necessary to know that these bits are latched at high-true TTL logic levels and will remain stable until the next character or byte is transmitted, no

```
10   REM OUTPUT A CR AND LF
20   OUT 255,13: GOSUB 100
30   OUT 255,10: GOSUB 100
40   RETURN

100  REM DELAY ROUTINE
110  FOR K = 1 TO 50
120  NEXT K
130  RETURN
```

Fig. 4. With the minimum handshake hardware shown in Fig. 3, the user must provide program delays to establish the character-to-character spacing. The BASIC language subroutine shown here will cause a carriage return and line feed to be output to the parallel port. The delay routine is consistent with a 110 baud (10 cps) printer.

matter how long this may be.

Concurrent with the latching of the data, the $\overline{WR}$ strobe will cause the $\overline{Q}$ output of the handshake flip-flop to switch to a logic low level. This "output data available" signal tells the outside world that a data byte has been placed in the latch. The outside world *must* respond with a low-going strobe to acknowledge "output data accepted."

As the schematic shows, this signal is connected directly to the RESET pin of the handshake flip-flop. A constant low level on this pin will inhibit any further change of state of the flip-flop. For this reason the data-accepted signal must be a strobe, not a constant low level.

Upon receipt of this strobe, the handshake flip-flop will return to its reset state, with the $\overline{Q}$ output at logic high. This output can be sensed by the driver software to determine that the port is ready to accept more data. This is shown by the line labeled I0B6. This signifies that this line can be read as the seventh bit (of eight) of the internal status port, using the common convention of counting the eight bits from zero to seven.

All the user needs to know is that if this bit is high the output port is ready to accept data. This can be determined by a machine-language instruction of IN A,0FE, followed by AND 40 to mask off this one bit, and then a test for nonzero.

A BASIC-language program can sense this bit also, with some difficulty. Executing the statement LET X = INP(254) will set the variable X equal to the decimal value of all the bits read through the status port. The bit in question has a decimal value of 64, as read by BASIC.

Therefore, if this bit is on, the total value of all the bits read together could range from 64 to 127 or from 192 to 255, depending on the state of the other bits connected to this port. These other bits include the input port status and the keyboard switches, so we have to consider their state as being indeterminate. Since BASIC has no bit-masking capability, a test for this bit will require determining if X falls within either of the two ranges of values given above.

As a result, it is easier for a BASIC-language print-driver program to ignore this status bit and merely provide an adequate delay between the output of one character and the next. Fig. 4 gives an example of a BASIC subroutine that will output a carriage return and a line feed to a 10 cps printer connected to the output port.

This is not a neat solution, however, but often an experimenter will not be too concerned with making everything as neat as would, say, a manufacturer. The "proper" way to use the parallel port would be for the device connected to issue the data-accepted signal only when it was ready to receive the next character.

If you find that it simplifies things to just include the delay loop in your driver program, then the strobe-generating hardware shown on the user's side of Fig. 3 is all you need to reset the handshake flip-flop following transmission of each character.

The two inverters and the slow-up capacitor C1 are used to delay the falling edge of the $\overline{Q}$ output for an interval of a few hundred nanoseconds to a few microseconds, depending on the value of C1 and the type of logic used. This delayed edge is then fed back to the flip-flop as its reset signal, causing the $\overline{Q}$ output to go high and returning everything to a steady state.

✓ Reader Service—see page 179

The strobe ($\overline{STB}$) thus created can then be used to clock the eight data bits into whatever device they are destined for.

Once again, this circuit is the *minimum* necessary to prevent hang-up of the handshake flip-flop and will require the driver software to provide the proper character-to-character spacing.

On to the Input

The parallel input port also uses a handshake flip-flop, but now it is the computer's responsibility to reset it. To input data from the outside world, the user simply supplies to the Sorcerer the eight data bits at TTL levels and a low-going strobe of a microsecond or so. The input data bits must then be held steady until read by a program statement.

As with the output port, the driver program will read the "input data available" bit (bit 7) with an IN A,0FE or LET X = INP (254). Now the machine-language mask for this bit will be AND 80. BASIC will have to test for a value of X in the range of 128 to 255 to determine if there is a character ready to be input.

If the status bit shows "data ready," either a machine-language IN A,0FF or a BASIC LET X = INP(255) statement will cause the computer to read the data on the input port lines, and the hardware will generate the read strobe $\overline{RD}$, which sets the input port handshake flip-flop. This produces a low level on the "input data accepted" line, signaling to the outside world that the data has been read and that another byte of data can be placed on the input-port lines and another strobe issued.

No Hang-ups, Please

The Sorcerer provides full buffering of the data lines on both the input and output ports, so no valid TTL level signal on them can cause trouble within the computer. However, the careless application of the wrong signal to either of the status lines, which are sensed by driver programs, could cause the Sorcerer to suddenly cease communication. Therefore, be sure you understand the functions of the signals on the parallel port pins 3 and 21.

The I/O drivers within the monitor make use of these sense bits, so if you assign the output to the parallel port, the monitor will expect the data-accepted strobe each time you try to print a character. If you don't get the strobe, or if the line is inadvertently held low by a wiring error or short, the Sorcerer will not be able to tell you what is wrong, in spite of all his magic. ■

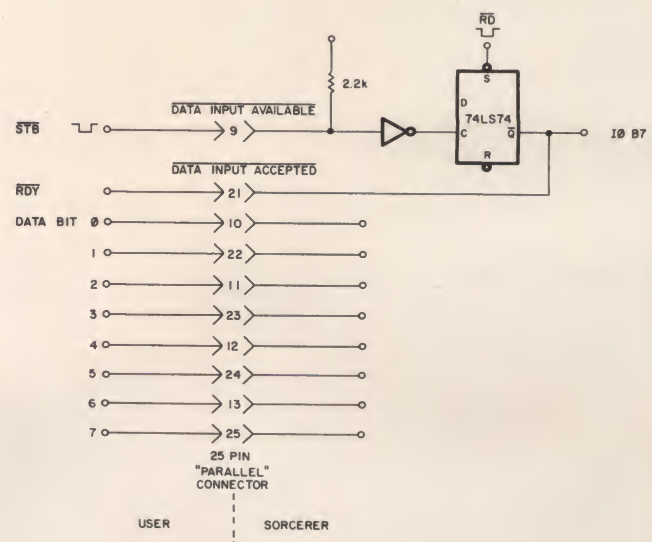
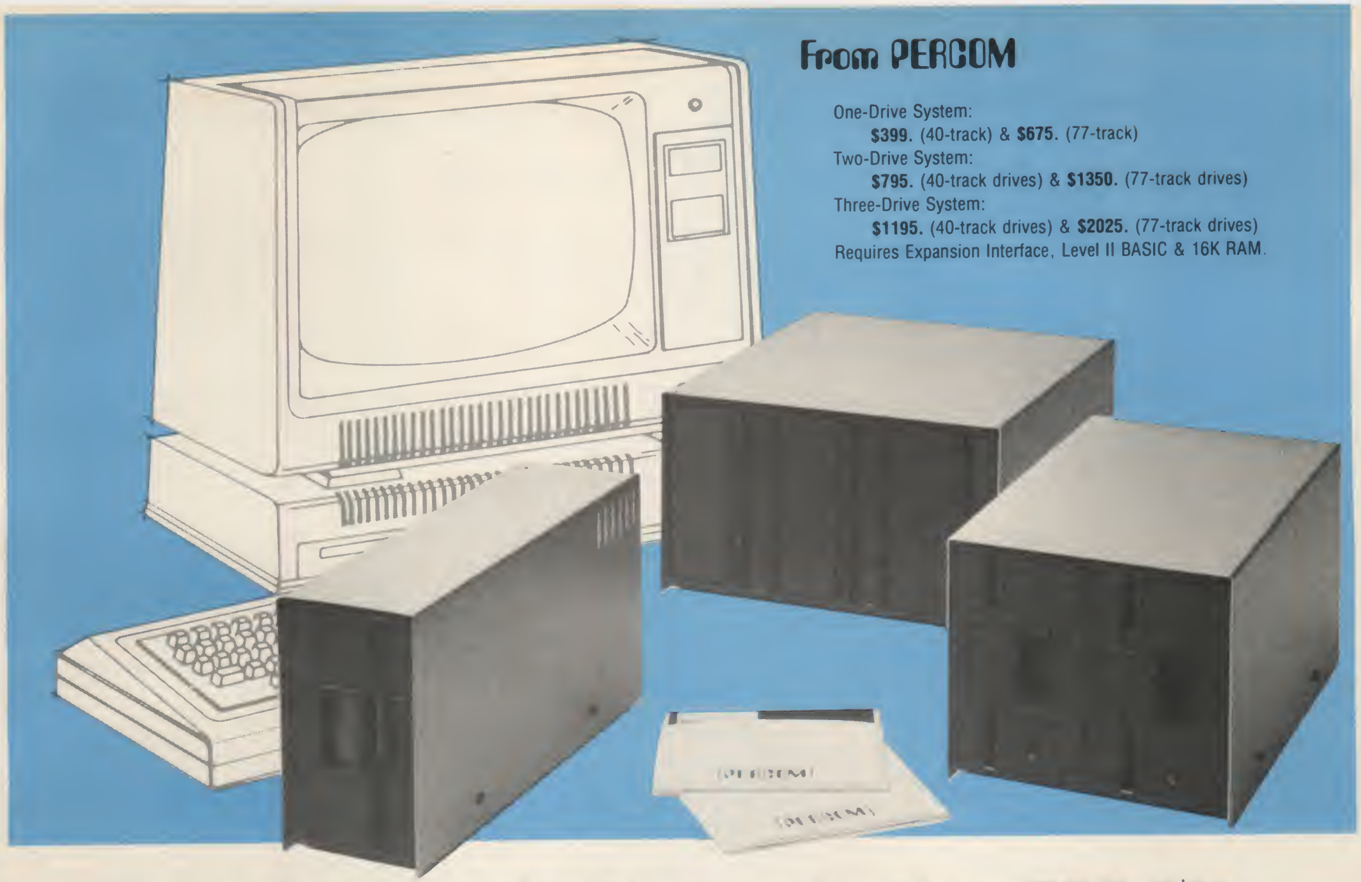


Fig. 5. To input a byte of data to the Sorcerer, the user provides latched data bits followed by a strobe ($\overline{STB}$). The internal handshake flip-flop will respond with a low-level data-accepted signal only after a program statement has read the data.

✓ Reader Service—see page 179



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- **Rat Trap**—Trap the rat in his maze with your two cats. For one player.
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These one player games require 8K of memory. **Order No. 0038P $7.95.**

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DESTROY ALL SUBS/GUNBOATS/BOMBER This package of three programs is fun for the whole family. Included are:
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- **Knight's Quest**—Battle demons to gain treasure and become a full fledged knight.
- **Robot Chase**—Destroy the deadly robots without electrocuting yourself.
- **Horse Race**—Place your bet and cheer your horse to the finish line.

These programs require a TRS-80 Level I 16K. **Order No. 0003R $7.95.**

DEMO I This package is just the thing to show your friends what your TRS-80 can do. Included are:
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- **Horse Race**—Place your bet and cheer your pony to the winner's circle.
- **ESP**—Test your powers of extrasensory perception.
- **Hi-Lo/Tic-tac-toe**—Guess the secret number or get three in a row.
- **Petals Around the Rose**—Can you figure out the secret behind the five dice?
- **Slot Machine**—Turn your computer into a one-armed bandit. These programs require a TRS-80 Level I 4K. **Order No. 0020R $7.95.**

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CASINO II This craps program is so good, it's the next best thing to being in Las Vegas or Atlantic City. It will not only play the game with you, but also will teach you how to play the odds and make the best bets. A one player game, it requires a PET 8K. **Order No. 0015P $7.95.**

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You'll need a TRS-80 Level I 4K, Level II 16K. **Order No. 0009R $7.95.**

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BACKGAMMON/KENO Why sit alone when you can play these fascinating games with your TRS-80?
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- **Keno**—Enjoy this popular Las Vegas gambling game. Guess the right numbers and win big.

You'll need a TRS-80 Level I & II. **Order No. 0004R $7.95.**

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CASINO I These two programs are so good, you can use them to check out and debug your own gambling system!
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- **Biorhythms**—Find out where your critical days are for physical, emotional, and intellectual cycles.

You'll need only a PET with 8K memory. **Order No. 0005P $7.95.**

BASEBALL MANAGER This pair of programs will let you keep statistics on each of your players. Obtain batting, on-base, and fielding averages at the touch of a finger. Data can be easily stored on cassette tape for later comparison. All you need is a PET with 8K. **Order No. 0062P $14.95.**

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A Telephone Data Coupler for the TRS-80

Build a TDC for only about $20, and exchange TRS-80 programs with friends and neighbors.

Fred G. Smith
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Athens GA 30606

Why not use the telephone to exchange your TRS-80 programs with your friends? You can easily build a Telephone Data Coupler (TDC) that looks and works like a commercial unit but costs only about $20. The heart of the TDC is a Realistic telephone amplifier made by Radio Shack. This professional-looking amplifier is easily converted into a data coupler.

Large computers use a separate modulator/demodulator (MODEM) to convert serial binary data to audio tones that can be transmitted over the telephone lines (see "Build the $35 Modem," *Kilobaud*, November 1977, p. 94). Small-computer systems have similar modulators and demodulators in their cassette interfaces, so that you only have to add the telephone coupler.

A transformer can be used to connect the cassette interface output with Ma Bell (see "Mickey Modem," *Kilobaud*, November 1978, p. 52), but there may be local regulations that limit the use of direct-line connections. Direct-wired couplers are also more difficult to disconnect if you move your system.

Photo 1. The Telephone Data Coupler connected to send a program from the TRS-80 cassette interface output. Some modification of the Realistic telephone amplifier is needed to make it function as a data coupler.

The Telephone Data Coupler described here uses simple acoustic and inductive coupling to link your computer to the handset of any standard (not GTE-type) telephone. A small speaker directs the cassette interface output into the handset mouthpiece, and an inductive pickup coil senses the incoming signals from the earpiece of the handset. Many commercial modems use this type of coupling because it is dependable and convenient.

Modification

The Realistic telephone amplifier (Radio Shack no. 43-230) has all of the essential parts needed for the TDC: a cradle to hold the handset, a pickup coil to receive data and an amplifier to boost the 800 mV TRS-80 output to speaker level. The only additional parts are two miniature phono jacks, a miniature phono plug and a 0.22 uF tantalum capacitor. The total bill should be about $20.

The telephone amplifier is easy to convert. Cut one inch off the back of the remote speaker case and mount the shortened case in the lower part of the mouthpiece chamber. Mount the two new jacks in the end panel of the amplifier case in line with the speaker output jack that is already there (see Photo 1). Disconnect the pickup coil leads from the printed circuit board and connect these leads to one of the new jacks (OUTPUT).

Wire the other new jack to the volume control with the 0.22 uF capacitor in the tip lead as shown in Fig. 1 (this is the TRS-80 jack). Wire the speaker to the amplifier output via the old speaker jack (now called TAPE).

Operation

The TDC is easy to use. There are three modes of operation: receiving, sending from the TRS-80 and sending from tape.

To receive, connect the OUTPUT jack of the TDC to the MIC (not the AUX) jack of your tape recorder (see Photo 2). Place the telephone handset on the TDC and record the incoming program as if it were coming from your computer.

To send from the TRS-80, insert the gray TRS-80 output plug into the TRS-80 jack on the TDC (see Photo 1). Load a program into the computer memory from tape or from the keyboard. Type CSAVE and press the enter key. Adjust the TDC volume control until the TRS-80 audio output is clearly audible in the TDC speaker. Place the telephone handset on the TDC,

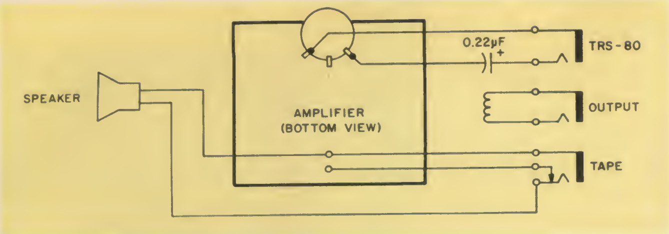

Fig. 1. Circuit diagram for the converted telephone amplifier.

type CSAVE again and press "enter" to send the program.

To send from tape, disconnect the TRS-80. Connect the tape recorder EAR jack to the TAPE jack of the TDC. Insert a program tape in the recorder and start it. Adjust the tape-recorder volume control until the tape output is clearly audible in the TDC speaker. Rewind the tape, place the telephone handset on the TDC and start the tape to send the program.

Comments

The Telephone Data Coupler has added a lot of pleasure to my personal computing. Local transmissions are dependable, but long-distance relays may not work; long-distance lines seem to have too much noise for reliable copying. Don't ever couple loud signals into the telephone, or annoying (and illegal) crosstalk can occur.

Transmissions from tape are not as reliable as transmissions directly from the TRS-80. The output of the computer has a more constant rate and amplitude than most tapes (see "Copying Computer Cassettes," *Kilobaud*, August 1978, p. 94). Use the TRS-80 whenever you can. It helps to place sponge rubber around the inside of the speaker chamber of the TDC to reduce the pickup of stray room noises.

I have prepared a 4K, Level I TRS-80 cassette tape that has several TDC programs you might find useful. The first program is an illustrated, step-by-step conversion plan to help you build the TDC. The second program explains and diagrams the testing and operation of the TDC. The last program shows how to use the TDC as a recording monitor, a music (?) machine, an audible logic probe and as other handy TRS-80 peripherals. The multiprogram cassette is available postpaid for $5.50 (check or money order) from Gnosis, Inc., Box 1911, Athens GA 30603. ■

Photo 2. The Telephone Data Coupler connected to the recorder in the receive mode. The interconnecting cable is modified from parts of the Realistic telephone amplifier.

✓ *Reader Service—see page 179*

The Cromemco Z-2D

A year of problem-free operation produced this hardware/software review of the Z-2D.

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Louisville KY 40206

I have wire-wrapped an 8008 system, written its monitor and spent lonely nights hand-assembling programs. As both a user and a dealer, I have done endless battle with a much-touted West Coast manufacturer of near-worthless hardware and nearly quit the microprocessor field as a result of the frustration. And, I have attempted to live entirely without a system.

The solution to the agonies of my existence (somewhere between the classifications of "serious hobbyist" and "microprocessor engineering firm") has become clear in the last year—twelve months untroubled by downtime, inadequate system software and uninterested manufacturers. For one year, I have lived with a Cromemco Z-2D.

Cromemco has done an admirable job integrating various hardware and software components into an efficient computer system. Originally a producer of "add-ons" for the Altair and Imsai markets, the company began in 1977 to produce its own S-100-based processor, the Z-2. It was instantly evident that they were addressing existing deficiencies in the field, as the mechanical design was not flimsy and the bus was quiet.

Encouraged by the Z-2's initial enthusiastic acceptance, Cromemco added the two Wangco minifloppies and their controller, which turn the mainframe into a Z-2D. An operating system called CDOS (originally a derivative of CP/M, now an enhancement thereof) was provided, supporting an excellent assembler, a comprehensive disk BASIC, FORTRAN IV, and recently, COBOL, a word processor, and a data base management system. In late 1977, when it was incorrectly assumed that the majority of microprocessor customers were hobbyists, most manufacturers would have long since engaged in the popular art of laurel-resting.

Throughout my involvement with Cromemco, the two most notable characteristics of the company have been its technical competence and its interest in helping users with problems. The latter is almost dizzying (in light of my hundreds of telephone and UPS dollars spent in the past in fruitless pursuit of factory support from one of the major entities in this strange new industry). Unhomogenized by longevity and complacency, the range of attitudes sported by the system manufacturers ranges from the "You bought it, it's yours" philosophy, which is most familiar, to Cromemco's almost embarrassing willingness to devote considerable energy to a problem and, yes, even return phone calls.

But enough plaudits; let's look at specifics.

Photo 1. Z-2D EPROM programming station. (Photos by Douglas Fowley)

Hardware

Photo 1 shows the system, which includes an EPROM programming station, an extension of the Cromemco Bytesaver contained in the mainframe, This allows unrestricted programming of 2708s without tearing into the system to get at the board.

Photo 2 shows the basic system peripherals. The Hazeltine 1500 CRT is interfaced by the disk controller board, which conveniently includes a programmable serial I/O port for the console. Presently there are two CRTs on the system (the second is an HP 2645A). The Diablo printer on the right is interfaced with a carry-over from my past: an Imsai PIO 4-4 Parallel I/O board (the printer needs three output ports and one input port).

The only items in the photograph that may give rise to questions are on top of the system cabinet. Under the oscilloscope is a unit I affectionately call the "Kludge Box," a buffered and isolated S-100 bus extension that provides 180 wire-wrap sockets. This allows plenty of room for all those little odds and ends that seem to get added to the system, without the major surgery that is so often undertaken. (This, along with the EPROM panel, is probably a contributor to the exceptional repair history of this system—one year with not one glitch.)

The sloppy bit of hardware on the right is associated with an experimental music system that, undocumented, had to remain undisturbed for the photograph. (No, the system is rarely this neat.)

If you look inside the Z-2D, first from the back, you will see the view as shown in Photo 3. This power supply provides 30 Amps of +8 V and 15 Amps each of +18 V and −18 V. The vertically oriented backplane may be seen, adorned by various boards (21 are allowed).

Photo 4 is a view of the system from the front, after the front panel with its two drives has been removed. The configuration at the time of the photograph included: 48K of RAM (using three of Cromemco's 16KZ dynamic RAM boards), disk controller, Processor Technology VDM-1, Cromemco Dazzler, Bytesaver, another 4K of RAM (noncontiguous), the interface to the Kludge Box, a custom development tool dubbed the Ramport and, of course, the Z-80 CPU board. The generally overworked bus lines with the system in action are unusually quiet, a major plus in the S-100 world.

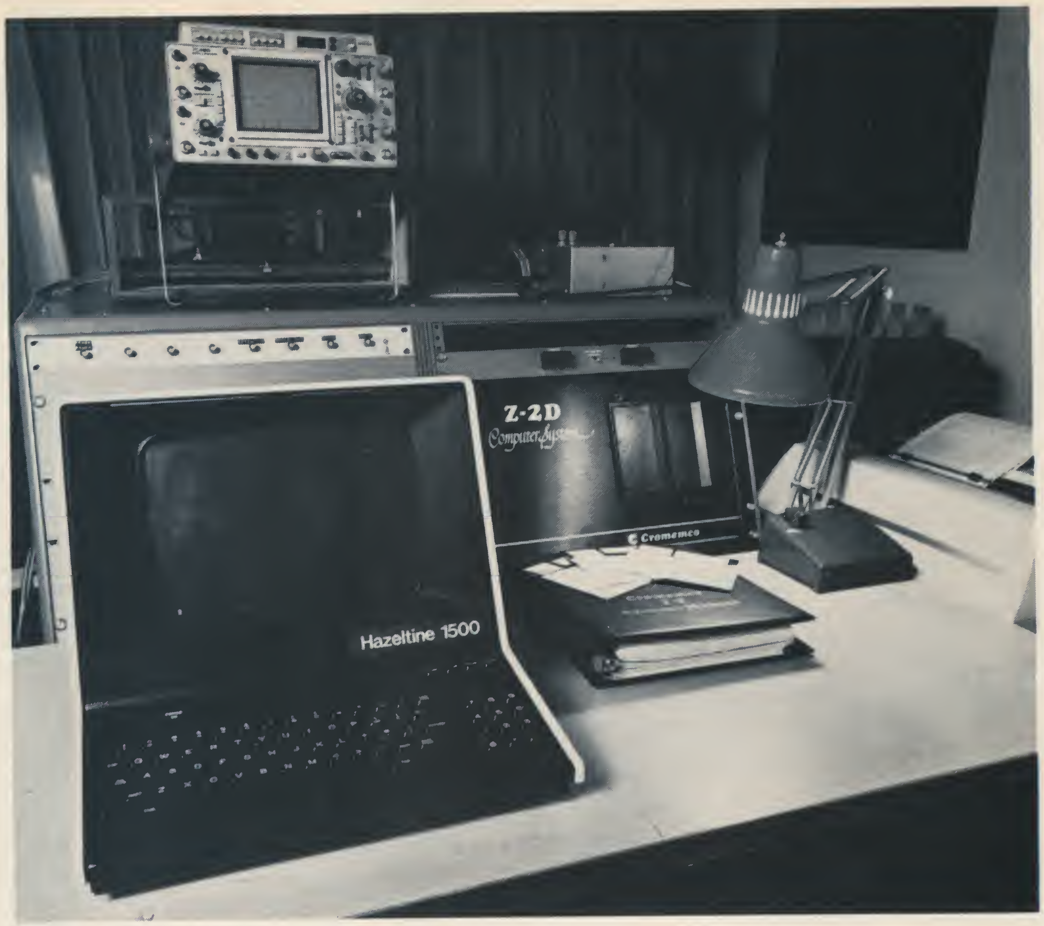


Photo 2. The author's system with peripherals.

The internal difference between the Z-2 and the Z-2D, apart from the presence of the disk drives and their controller, is that the entire card cage has been moved back from its original position near the front of the cabinet. This is not readily apparent in the photo, due to foreshortening, but it has the effect of changing airflow of the original design. Rather than pulling the air directly through the card cage, the fan now draws the air past the disk drives and over the top of the cards. This appears to be an adequate means of heat dissipation, but is probably less than optimal.

Assembly of the kit system was a surprise: It worked the first time, 48K of RAM included. Cromemco replaced a Wangcc drive with a bad write-protect sensor within four days, and I had a couple of minor problems interpreting their early documentation (that was late 1977 —it has long since been polished).

The architecture of the system is well defined by the Z-80 itself; the details of interfacing, interrupts, direct memory access and the like are better gleaned from the wealth of S-100 and Z-80 literature with which our industry abounds. The only comment I can make, as a microprocessor system designer, is that they did it well.

Software

Once a computer system is implemented and screwed into its cabinet, it should become more or less invisible to the user. When I am sitting at the terminal writing an article, I am not really concerned with the hardware; I merely have faith in its function. The real strength of a system lies in its software. Clumsily written code in crucial areas of an operating system has been the death of many a hot new product.

I should preface the discussion of the Z-2D's software with a few comments about my use of the system, lest I be accused of esoterica-mongering or even wanton purism. Apart from all the fun things (music, graphics, games, etcetera, ad nauseam), I use my system heavily and daily for two types of tasks: the generation of article manuscripts and the development/simulation of software for custom products with single board computers inside. (The latter is the output of the microprocessor engineering firm known as Cybertronics, Inc.)

Word processing on the Z-2D was recently made possible by an impressive software package called the Text Formatter, a stand-alone program that accepts a raw text file (prepared with the Text Editor) as input and produces formatted pages as output. Title centering, underlining, page numbering, right-justification (tailored either to matrix or Diablo/Qume/NEC printers) and multi-diskette files are all handled with ease. (My typewriter, dusty, fallen from glory, now dozes under the inevitable stack of papers, awaiting the occasional opportunity to address an envelope. I don't miss it, or the chalk paper.)

But word processing is a fairly pedestrian business function, associated with offices and IBM commercials. The area in which I am most frequently amazed at the quality of the software is in the system's use as a development tool.

It can be frustrating to develop code for single board processors. The ones we most frequently use—Intel SBC 80/04s —have no resident monitor, take their instructions from 4K of ROM space and offer a whopping 256 bytes of scratchpad RAM. At $195, the SBC 80/04 is a multifaceted device, but devoid of frills. Obviously, a development system is necessary.

Intel suggests the MDS, an

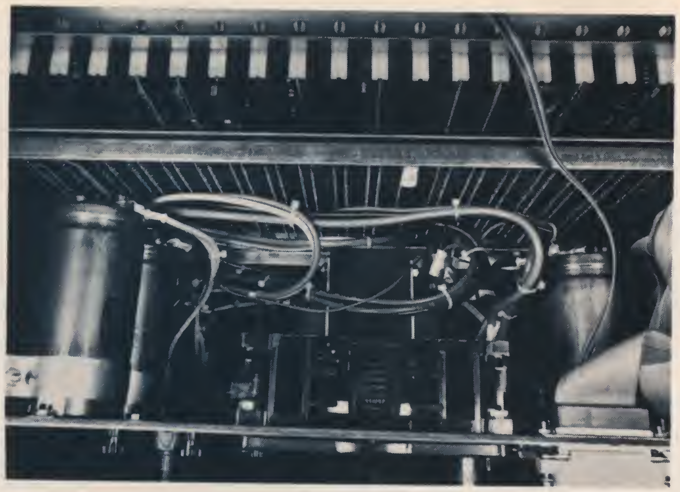


Photo 3. Rear view of the Z-2D showing power supply and backplane.

excellent product which, with the software known as ISIS and its partners, makes a superb development tool for the single board processors. The only problem is the near-$20,000 price tag.

The Z-80 assembler provided by Cromemco, along with a package called, appropriately, DEBUG, is a good start. Software can be produced on the system with the editor, assembled and burned into EPROMs, which are then plugged into the single board computer. However, I don't know about you, but a successful piece of custom software around here usually has a revision number between 30 and 60. That's a lot of EPROM burning.

So, the Ramport was born. 2K of RAM is wire-wrapped onto a Vector 8800V prototype card, along with some multiplexing and control logic. Normally, it looks like any other RAM in the system, but when a certain output instruction is issued, it becomes—voilà!—an exact imitation of a 2716 EPROM on the end of a 24 conductor DIP cable, which happens to be plugged into the SBC 80/04.

Issuance of a RESET to the SBC causes it to begin executing the code in what it assumes is its ROM, allowing revision after revision to be generated without using the EPROM programmer. And since it is RAM, its mode can be toggled back and forth between internal and external, allowing patches and something more: Simple modification of the SBC allows it to write into its ROM (the 2K RAM), and a few short utilities under system control cause the SBC to transfer its scratchpad and all of its registers into memory visible to the development system.

Now, with this effective little interface, the Z-2D can take the place of a system costing more than twice as much. With the ability to produce relocatable code via an assembler, which allows such niceties as conditional assemblies and disk macro libraries, it is almost fun (well, let's not get carried away) to develop software for external processors or, of course, for the Z-2D itself.

A quick comment on macros is justified. With such a large portion of most assembly-level programs consisting of utilities and blocks of code that are universally handy, it is worthwhile to build a macro library of utilities and incorporate it on the assembler disk. When the assembler encounters a macro call, it checks for reference to the external file, then wanders off to the library and extracts the needed code. As the library grows, it becomes more and more possible to write entire programs consisting of nothing but macro calls. This is an ideal way to write your own high-level language, exquisitely tailored to your specific requirements.

It's easy to stray into the finer points of computer use when talking about the Cromemco system, and while questionable from a literary standpoint, that is a good sign. The best index of a computer system's value is the extent to which it makes its presence felt: the less the better. The operation of the Z-2D is smooth, reducing to almost zero the occasions when it is necessary to pay attention to the system itself.

We're into this, most of us, because we see potential in the use of microprocessors as "thought amplifiers." We are aware that the marriage of the human mind, with all its abstraction and pattern-recognition capability, to the computer, with its swiftness of calculation and flawless memory, offers unprecedented opportunities for creative expression and practical enrichment of our lives.

The less we have to fiddle around with the interface between ourselves and our machines, the better we can address ourselves to the tasks at hand.

In the never-ending asymptotic approach to the *ideal*, the Cromemco Z-2D remains refreshingly in step with the state of the art. ■

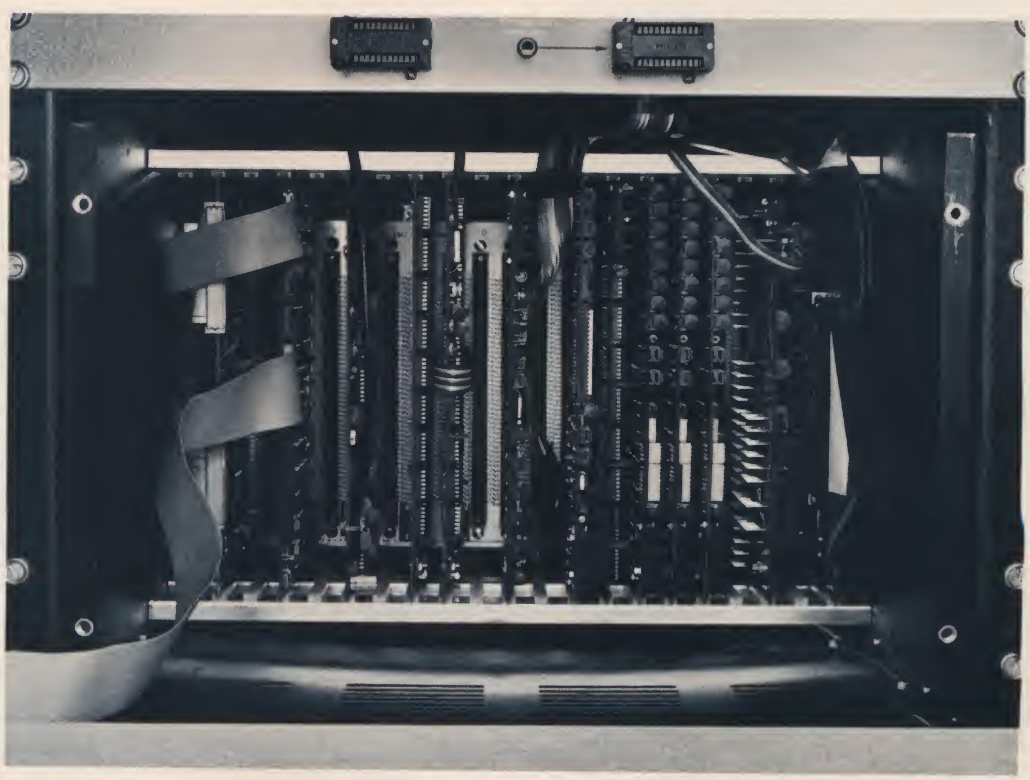
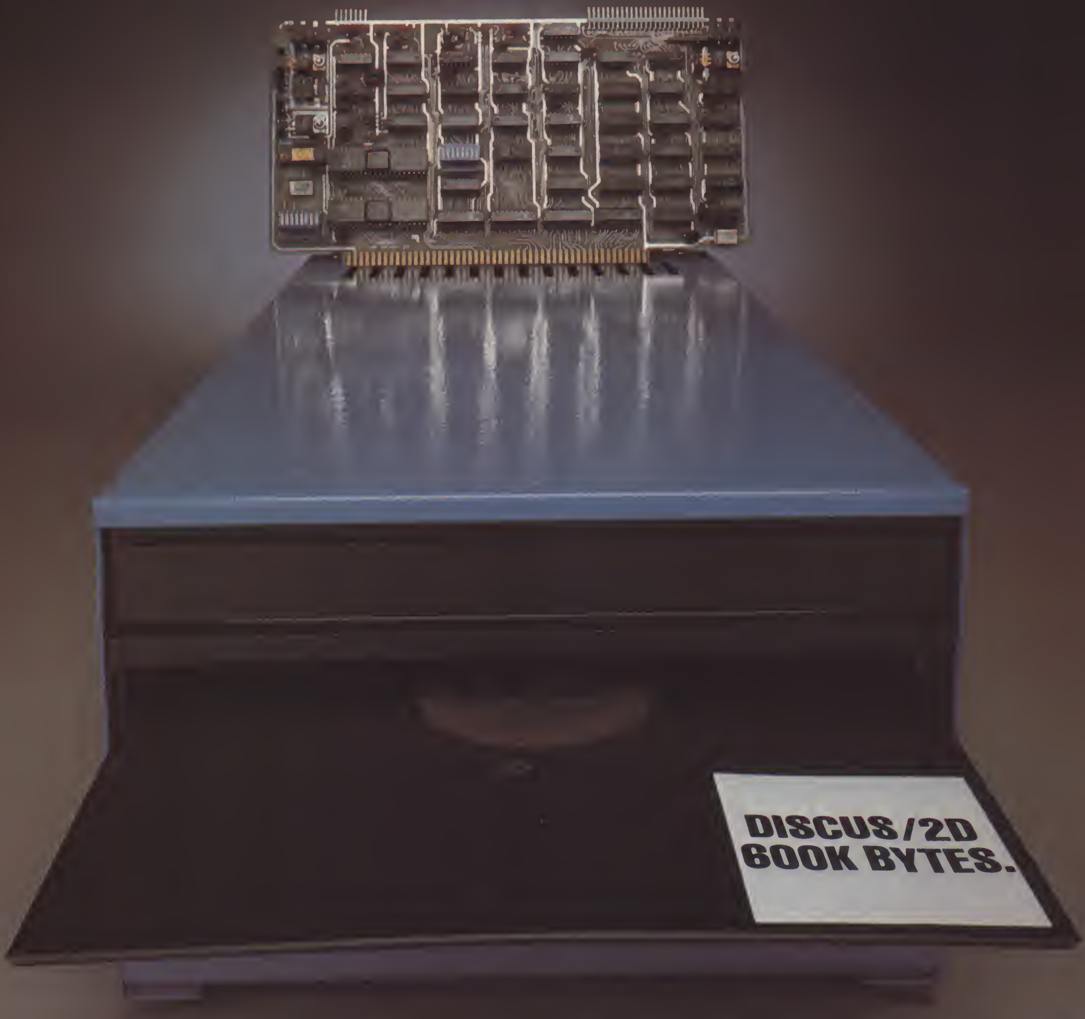


Photo 4. Front view of the system.

DOUBLE DENSITY



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Did you ever have one of those days when you must get one good print from each of 12 negatives, but you only have 14 sheets of paper? Or did you ever have to produce one or two prints each of 100 negatives — today (and it's noon already)? Or did you ever want to start working on the display-quality print that you knew a negative could give, but you really didn't want to be bothered with making test prints? Well, then, this program is for you.

It runs in about 6K, including 4K of BASIC, but not including the REMs. It should run on any BASIC that handles decimal fractions. Although this program will not transform you into an excellent photo-printer, it will enable you to produce your usual-quality prints much more quickly. To fully utilize this program, you will have to own or have access to a transmission-type densitometer, a computer, a ruler or tape measure, and whatever other darkroom equipment you need to print black-and-white film. Furthermore, you will need a knowledge of good photographic and densitometric practice.

Program Origin

The incubation of this program was fairly long. Not long ago, I was a free-lance photographer who also did a lot of lab work. I would have been happy to get print orders for hundreds of prints from one or two negatives; instead, I received orders for one or two prints from hundreds of negatives. Each print required a test print, or two, and this did not help my disposition or profits.

I wanted a densitometer to cut down my printing chores, but they were too expensive. I felt that although an on-easel printing meter would be cheaper, it would also be less versatile (you can print with a densitometer, but you can't read negative densities with an on-easel printing meter).

Then one day I was looking for a bottle of toner in a camera store I did not usually frequent and found, instead, a dusty old Kodak Model 1 Densitometer for $25. (For any non-photographers: this is like finding an ASCII-coded Selectric in good condition for about $200.) I asked the clerk if it worked, and he replied, "If you'll tell me what it's supposed to do, I'll try to find out."

We plugged it in, turned it on, and tried it out on some negatives he had in the store; both lights lit, all of the controls and knobs turned and seemed to control what they were supposed to. So, I bought it, took it home and, after some cleaning and repairing, began using it. It took me about five minutes to read a negative and calculate the new exposure time (on a hand-held four-banger), but it still beat doing test prints.

Around the same time, I started seeing articles in magazines, and then entire magazines, devoted to microcomputers. I bought an SWTP 6800, and soon I was playing games on it. Then one day it dawned on me — let the computer do the number-crunching drudgery; so I wrote this program.

My goals were to write a program that *would*:

1. Determine correct exposure time and f-stop for four film formats, given the highlight density of the new negative and the size of the new print.
2. Attempt to keep the exposure time between 5 and 30 seconds.
3. Restrict the number of decimal places in the exposure time to the accuracy of my Heathkit photo timer (i.e., to the nearest 1/10 second below ten seconds and to the nearest second above ten seconds).
4. Give me the option of reprinting a negative at a new size with a minimum of keystrokes and mental effort.
5. Give me the option of letting the computer determine the paper grade, and adjusting the exposure time for the new paper grade. (This, I told myself, is for when I print other peoples' negatives, since I have deluded myself into thinking that all my negatives print on #2 paper — just as all my programs run the first time.)

Four Factors to Consider

Basically, four factors ef-

fect the exposure problem: (1) the standard printing time, (2) the highlight densities of the standard and the new negatives, (3) the size of the old and new prints, (4) the paper-grade correction factor.

Let's look at them one at a time.

The standard printing time. This, and all your standard data, is obtained in the process of making a good print. It is the reference point from which you work. It is important to realize that the prints this program produces will usually be of about the same quality as the standard print. If the standard print is too dark, the prints the program produces will be too dark.

The highlight densities of the standard and new negatives. Highlights are the lightest areas of the print and the darkest areas on the negative. The rendition of the highlights is controlled by printing time (a small change in printing time will change the rendition of the highlights, leaving the shadows basically unchanged). So, printing time is controlled by the highlight densities, and the relationship is this:

$$A = 10\uparrow(ABS(H(Y) - H(1)))$$

where A is the density-correction factor, H(Y) is the standard highlight density for the format being printed and H(1) is the new highlight density.

The size of the old and new prints. The print exposure time is further determined by the brightness of the light that falls on the paper, in turn controlled by the distance between the enlarging head and the paper. Like most projected light, the light leaving the enlarger describes a conical solid, so the intensity of the illumination is controlled by the inverse-square law. That is, when the distance between the enlarger head and the paper doubles, the diameter of the conical section doubles, and the area increases by a factor of 4. The same amount of light leaves the enlarger in either case, so the intensity decreases with the area being illuminated, or by a factor of 4, which in turn means that the exposure must be increased by a factor of 4 (see Fig. 1).

To simplify: If we measure the length of the *entire* projected image for both the standard and new negatives, the area of the projection will have changed according to the square of the sides. In the program, the relationship is expressed as in Example 1, where C is the size-correction factor, L(1) is the new print size, and L(Y) is the standard print size for the format being printed. To clarify: The entire projected length of the negative is measured, *not* just the part that you are printing!

$$C = (L(1)*L(1))/(L(Y)*L(Y))$$

Example 1.

The paper-grade correction factor. Just as the exposure time controls the highlights of the print, so the shadows, or dark areas of the print, are controlled by the paper grade and developing time of the paper. The developing time is best left constant at a carefully controlled 2½ minutes. The print quality cannot be judged except in room (white) light; and if developing time has not been closely monitored, it is difficult to repeat or correct. The exception is when fine-contrast controls on the order of ½ paper grade or less are needed.

A more thorough dis-

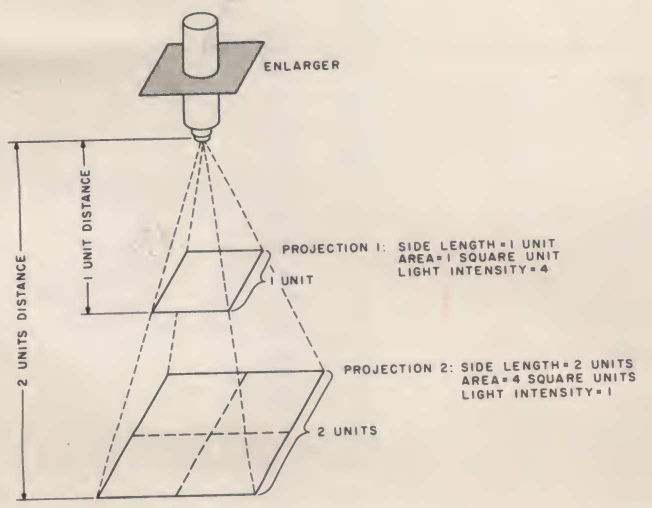


Fig. 1. The intensity of the light falling on the easel varies with the square of the distance, or in direct proportion to the projected area.

Program listing.

```
*G
READY
#LOAD
0001 REM PHO-OPS VERSION 1.5
0002 REM TEST PRINT ELIMINATOR
0003 REM
0004 REM BY MICHAEL F. AVERY
0005 REM
0006 REM
0007 REM
0008 REM THE DATA IN THE LINES
0009 REM BELOW MUST BE CHANGED
0010 REM FOR YOUR SYSTEM.
0011 REM 35MM HI,TIME,F/,SIZE
0012 DATA .90,7.8,5.6,5.5
0013 REM 2 1/4 ^2
0014 DATA .95,8.2,8,8
0015 REM 2 1/4 X 3 1/4
0016 DATA .95,8.2,8,8
0017 REM 4X5
0018 DATA 1.1,18,8,5.875
0020 DIM H(6),S(6,6),T(6),V(6),L(6)
0021  M=0
0030 REM THE LINES BELOW HAVE
0031 REM CONTRAST LEVEL DATA
0032 REM FOR THE 6 PAPER GRADES
0033 REM AND THE 4 FILM FORMATS.
0034 REM GRADES 0,1,2,3,4,5
0035 REM 35 MM
0036 DATA .6,.5,.4,.3,.2,.1
0037 REM 2 1/4 ^ 2
0038 DATA 1.6,1.4,1.2,1.0,.8,.6
0039 REM 2 1/4 X 3 1/4
0040 DATA 1.6,1.4,1.2,1.0,.8,.6
0041 REM 4 X 5
0042 DATA 1.6,1.4,1.2,1.0,.8,.6
0099 REM THIS READS THE DATA IN LINES 10-20
0100 FOR Z=3 TO 6 STEP 1
0120 READ H(Z),T(Z),V(Z),L(Z)
0140 NEXT Z
0141 REM THIS READS THE SHADOW
0142 REM DENSITY MATRIX.
0143 FOR Y=3 TO 6
0144 FOR Z=1 TO 6
0145 READ S(Y,Z)
0146 NEXT Z
0147 NEXT Y
0150 GOSUB 2200
0160 PRINT "FILM FORMATS:"
0170 PRINT "1=35 M.M."
0180 PRINT "2=2 1/4 ^2"
0190 PRINT "3=2 1/4 X 3 1/4"
0200 PRINT "4=4 X 5"
0210 PRINT "WHICH FORMAT WILL YOU BE "
0220 PRINT "PRINTING (PLEASE TYPE A NUMBER"
0221 PRINT "FROM ABOVE)";
0230 INPUT Y
0239 REM THIS LINE MAKES Y A USEFUL POINTER
```

```
0240  Y=Y+2
0241 PRINT "DO YOU WANT THE PAPER GRADE"
0242 PRINT "OPTION (0=NO,1=YES) ";
0243 INPUT G
0249 GOTO 270
0250 PRINT "CONTROL COMMANDS ARE:"
0251 PRINT "1=NONE(CTRL STATUS REMAINS QUO)."
0252 PRINT "2=REPRINT NEG. AT NEW SIZE."
0253 PRINT "3=RESET CTRL STATUS."
0254 PRINT "CONTROL COMMAND ";
0255 INPUT W
0260 ON W GOTO 270,285,150
0270 PRINT "HIGHLIGHT DENSITY ";
0271 INPUT H(1)
0275 IF G=0 THEN 285
0280 PRINT "SHADOW DENSITY ";
0281 INPUT S(1,1)
0285 PRINT "PRINT SIZE ";
0286 INPUT L(1)
0287 IF H(Y)=H(1) THEN A =1
0288 IF H(Y)=H(1) THEN 320
0290  X=ABS(H(Y)-H(1))
0291 REM LINE 290 DETERMINES
0292 REM THE DIFFERENCE IN
0293 REM DENSITIES BETWEEN
0294 REM THE HIGHLIGHTS IN
0295 REM THE STANDARD NEGATIVE
0296 REM AND THE ONE YOU ARE
0297 REM PRINTING.
0300 GOSUB 3000
0305 REM LINE 310 CORRECTS FOR
0306 REM WHEN THE NEW NEG IS
0307 REM THINNER THAN THE STD.
0308 REM NEG.
0310 IF H(Y)>H(1) THEN A=1/A
0315 REM LINE 320 CORRECTS FOR
0316 REM DIFFERENT PRINT SIZES.
0320  C=(L(1)*L(1))/(L(Y)*L(Y))
0321  R=1
0325 REM R IS THE PAPER GRADE
0326 REM EXPOSURE MULTIPLIER FOR
0327 REM ILFORD PAPER,& CAN BE
0328 REM CHANGED IN SUBR. 5000
0329 REM FOR GRADE 5 ILFOBROM.
0330 IF G=1 THEN 5000
0340  V(1)=V(Y)
0341 REM LINE 350 CALCULATES
0342 REM EXPOSURE TIME BY
0343 REM MULTIPLYING BASE
0344 REM EXP. TIME X NEW
0345 REM DENSITY FACTOR
0346 REM X THE SIZE FACTOR.
0350  T(1)=T(Y)*C*R*A
0351 REM LINE 360 & 370 KEEP THE
0352 REM EXPOSURE TIMES BETWEEN
0353 REM 5 AND 30 SECONDS,WHEN
0354 REM POSSIBLE.
0360 IF T(1)<5 THEN 7000
0370 IF T(1)>30 THEN 7000
0371 REM LINES 380 & 381 KEEPS
0372 REM FROM SHOWING MORE
0373 REM PRECISION THAN MY TIMER
0374 REM CAN HANDLE.
0380 IF T(1)<10 THEN T(1)=(INT((T(1)*10)+0.5)/10)
0381 IF T(1)>=10 THEN T(1)=INT(T(1)+.5)
0382 GOSUB 2200
0383 PRINT "EXPOSURE TIME = ";T(1);" SEC."
0390 PRINT CHR(64);" F/";V(1);"."
0400 IF G=1 THEN PRINT"CONTRAST GRADE = ";Q
0401  M=M+1
0410 PRINT "ANOTHER PRINT (0=NO,1=YES)";
0420 INPUT Z
0430 IF Z=0 THEN 440
0431 IF M<3 THEN 250
0432 GOTO 254
0440 PRINT "I HOPE I WAS HELPFUL TO YOU."
0450 PRINT "SEE YA SOON."
0460 STOP
1999 REM LINES 2200-2201
2000 REM GENERATE A CLEAN
2001 REM SCREEN ON A SWTP CT-
2002 REM 1024. FOR 8K BASIC,
```

cussion of paper grade will appear later in this article. At present, what concerns us is that different paper grades have different printing speeds, just as different films have different film speeds. In fact, for most brands of paper, each paper grade has a different printing speed. This would really muddy the water — if there weren't an easy way out.

A British company, Ilford, makes an enlarging paper called Ilfobrom, which is available in grades 0, 1, 2, 3, 4 and 5. Grades 0-4 have exactly the same printing speed; grade 5 has exactly ½ the printing speed of the others.

Coupling this with an assumption that the standard print was *not* printed on grade 5 paper makes the paper-grade correction factor quite simple. If the new print is to be printed on #5 paper, then double the calculated exposure; otherwise use the calculated exposure. In the program it looks something like this:

```
R=1
If Q= 6 THEN R=2
```

where R is the paper-grade exposure-correction factor and Q is the paper grade (+1) being used.

Every time I think about rewriting the program to use paper other than Ilfobrom, I get a headache. It is fortunate that Ilfobrom is an excellent, easy-to-use paper. I used it long before I wrote this program, and long before I even thought of owning a densitometer. I encourage you to try Ilfobrom, even if you don't use this program to help you print.

The final exposure time formula looks like this:

```
T(1) = T(Y)*C*R*A
```

where T(1) is the new printing time, T(Y) is the standard printing time for the format being printed, C is the size correction factor, R is the paper-grade correction factor, and A is the highlight-correction factor.

The next problem is determining the "correct" paper grade to use. The first assumption made here is that you want a "normal" print, ranging from crisp, clean whites to deep, rich blacks. This is not always the case, though. Sometimes a high- or low-key print is desired, which is one reason the paper-grade selection subroutine was left as an option. The paper grade is determined by the contrast, or density range, of the negative to be printed — that is, the density difference between the highlight and shadow densities.

What negative range corresponds with which paper grade depends (among other things) on the following: (1) the film size being printed, (2) the enlarger type (i.e., condenser, diffusion, point source, etc.) and (3) the desired results. The program has been set up for four film formats, my condenser enlarger and my personal prejudices concerning print quality. You may need to change the data in lines 36, 38, 40 or 42 to correspond to your enlarger type, film formats and ideas about print quality.

The program is self-explanatory and self-prompting, so there should be no problem.

Program Construction

The subroutine at line 2200 generates a clean screen on an SWTP CT-1024. This may be deleted if you are using a Teletype, or changed for other TTVs (if necessary).

The subroutine at line 3000 is a base-10 anti-log subroutine, needed because density is the base-10 log of opacity, and opacity values are needed for the calculations. In SWTP 8K BASIC, the instruction "300 A = 10 ↑ X" would do what the subroutine does. However, the early versions of this program filled up my computer's memory when I used 8K BASIC, so I wrote the subroutine and still had enough

memory to finish writing the program. Since then, I have noticed that the subroutine seems to run faster than the 8K BASIC statement.

The subroutine from 4999 – 5100 determines the paper grade, and (if necessary) changes the paper-grade exposure-correction factor, R, based on the values in lines 36, 38, 40 and 42, as read by lines 143-147. The subroutine can be modified for your system and standards, but it is set up for Ilfobrom paper, and that is not easily changed (If I receive enough requests, I will rewrite the program to accommodate papers other than Ilford – even though I don't consider the conversion effort worthwhile.)

The subroutine between lines 6999 and 7200 attempts to keep the exposure time between 5 and 30 seconds. I feel that most timers are too erratic below five seconds (with a mechanical timer I would not use an exposure time of less than 10 seconds) and that a printing time over 30 seconds is too long to wait in a production-printing situation. Again, this subroutine has been set up for my enlarging lenses and may need to be changed for your lenses.

My lenses for 2¼ x 2¼ and larger formats have the same f-stop range, so in line 7000, the subroutine branches into two parts – 35mm and "other." By deleting the REMs between 7001 and 7011, the subroutine can be rewritten to branch to a different section for every unique lens.

The subroutine then assigns the f-stop (V(1)) a new value, K; increments or decrements K, depending on whether the exposure time is too long or short; adjusts the exposure time accordingly; and then converts K to an f-stop number assigned to V(1). Please note the care taken with the 2¼ X 2¼ and larger lenses, which in my system have a ½-stop increment between the maximum and next to maximum openings, and exercise the same caution with your lenses.

The first step in using this program is to enter it into your computer, deleting all of the REMs after line 150 except for lines 3000, 4999 and 6999. If necessary, change or delete the subroutine at line 2200.

The second step is to make a good print on any grade of paper *except* grade 5, remembering that the quality of the calibration print determines the quality of the prints the program will produce. Then, carefully record the entire projected length as well as the highlight and shadow densities of the negative, along with the exposure time, f-stop and paper grade used. Check lines 11-18 to determine on which line the data for the format you are printing belongs, and change the line to hold your data in the following order: highlight density, exposure time, f-stop and print size (in decimal inches).

Type RUN, select the format you have been printing, exercise the paper-grade option, and reenter the standard data as it is requested. You should receive as output the exposure time and f-stop you were using, at the same paper grade you were using. If the paper grade is off, check lines 30-42 and find the lines containing the contrast data for the format you are printing. If the output paper grade was too high, increase all the numbers on that line by .10. If the output contrast is too low, decrease the numbers on the line by .10.

Repeat the above steps until the contrast is right. This calibration needs to be repeated for every film format you wish to print. Once the calibration is complete, you should not have to recalibrate the contrast selector subroutine, although it may be necessary to enter new values for the highlight density, exposure time, print size and f-stop. These change due to factors such as enlarging-lamp

```
2003 REM THE INSTRUCTION SHOULD
2004 REM BE CHANGED TO CHR$(16)
2005 REM ;CHR$(22);
2200 PRINT CHR(16);CHR(22);
2201 RETURN
2990 REM LINES 3000 - 4100 ARE
2991 REM A BASE 10 ANTI-LOG SUB-
2992 REM ROUTINE.THIS GENERATES
2993 REM THE CORRECTION FACTOR
2994 REM FOR VARYING NEGATIVE
2995 REM HIGHLIGHT DENSITIES.
3000 REM BASE TEN ANTI-LOG SUBROUTINE
3004  E=2.71828
3005  X=2.302582*X
3010  I=INT(X+.5)
3015  F=X-I
3020 IF F = 0 THEN 3040
3021  D=ABS(F)
3030  P=1+D*(1+.4926*D*(1+.4153*D))
3031 IF F<0 THEN P=1/P
3035 GOTO 3050
3040  P=0
3050 IF I<2 THEN 3080
3055  B=E
3060 FOR N=2 TO I
3065  B=B*E
3070 NEXT N
3075 GOTO 3086
3080 IF I=0 THEN B=1
3085 IF I=1 THEN B=E
3086 IF P=0 THEN 4000
3087 IF B=0 THEN4002
3090  A=P*B
3095  A=(INT((100*A)+.5))/100
3099 RETURN
4000  A=B
4001 GOTO 3095
4002  A=P
4003 GOTO 3095
4080 REM LINES 4999-5100 ARE
4081 REM THE PAPER GRADE SUB-
4082 REM ROUTINE.IT IS SET UP
4083 REM ILFORD ILFOBROM PAPER.
4084 REM THE CONTRAST VALUES
4085 REM MAY NOT BE OPTIMUM FOR
4086 REM YOUR SET-UP & CAN BE
4087 REM EASILY CHANGED.
4088 REM SETTING UP THE EXPOSURE
4089 REM CHANGES FOR PAPERS
4090 REM OTHER THAN ILFORD
4091 REM WOULD BE VERY HARD TO
4092 REM DO. FORTUNATLY ILFORD
4093 REM IS A TRULY EXCELLENT
4094 REM PAPER, AS WELL AS CON-
4095 REM VIENIENT TO USE.
4999 REM PAPER GRADE SUBR.
5000 REM FIND CONTRAST RANGE
5001  O=H(1)-S(1,1)
5015  Z=1
5020 REM FIND PAPER GRADE
5021 IF O>=S(Y,Z) THEN Q=Z
5022 IF O>=S(Y,Z) THEN 5027
5023 IF Z=6 THEN 5026
5024  Z=Z+1
5025 GOTO 5021
5026  Q=Z
5027 ON Q GOSUB 5900,5902,5902,5902,5902,5952
5028  Q=Q-1
5029 GOTO 340
5900 PRINT "THIS NEGATIVE MAY BE TOO"
5901 PRINT "CONTRASTY TO PRINT WELL."
5902 RETURN
5952 PRINT "THIS NEGATIVE MAY BE TOO FLAT"
5953 PRINT "TO PRINT WELL."
5954  R=2
5955 RETURN
6080 REM LINES 6999-7200
6081 REM CORRECT THE EXPOSURE
6082 REM AND F/STOP IN AN
6083 REM ATTEMPT TO KEEP THE
6084 REM EXPOSURE TIME BETWEEN
6085 REM 5 & 30 SECONDS.
```

```
6086 REM THE TABLES ARE SET-UP
6087 REM FOR MY ENL. LENSES
6088 REM MAX. & MIN. APETURES
6089 REM AND MAY NEED TO BE
6090 REM CHANGED FOR YOUR
6091 REM LENSES. BE CAREFUL
6092 REM OF LENSES THAT HAVE
6093 REM 1/2 STOPS BETWEEN THE
6094 REM MAXIMUM AND NEXT TO
6095 REM MAXIMUM APETURE, AND
6096 REM ALLOW FOR THIS,AS I
6097 REM DID ON THE 2 1/4 SQR.
6098 REM & LARGER FILM SUB-R.
6999 REM F/STOP SUBR.
7000 IF Y=3 THEN 7170
7001 REM WHAT FORMAT? IF 35
7002 REM THEN GOTO 7170
7010 REM ASSIGN USABLE NUMBER
7011 REM TO F-STOPS.
7015 IF V(1)=4.5 THEN K=0
7020 IF V(1)=5.6 THEN K=1
7030 IF V(1)=8 THEN K=2
7033 IF V(1)=11 THEN K=3
7036 IF V(1)=16 THEN K=4
7040 IF V(1)=22 THEN K=5
7042 REM IS T TOO BIG, OR TOO
7043 REM SMALL?
7045 IF T(1)<5 THEN 7075
7048 REM IF LENS IS ALL THE WAY
7049 REM OPEN,THEN GO BACK TO
7050 REM MAIN PROGRAM.
7051 IF K=0 THEN 380
7054 REM ADJUST F/STOP.
7055  K=K-1
7059 REM 1/2 STOP INCREMENT?
7060 IF K=0 THEN 7105
7064 REM ADJUST TIME
7065  T(1)=T(1)/2
7070 GOTO 7130
7071 REM IF LENS IS SHUT DOWN
7072 REM ALL THE WAY THEN GO
7073 REM BACK TO MAIN PROGRAM.
7075 IF K=5 THEN 380
7080  K=K+1
7083 REM WATCH OUT FOR THE 1/2
7084 REM F/STOP INCREMENT!
7085 IF K=1 THEN 7125
7089 REM ADJUST TIME FOR NEW F/.
7090  T(1)=T(1)*2
7100 GOTO 7130
7105  T(1)=T(1)/1.5
7115 GOTO 7130
7125  T(1)=T(1)*1.5
7126 REM REASSIGN F/ NUMBERS
7130 IF K=0 THEN V(1)=4.5
7135 IF K=1 THEN V(1)=5.6
7140 IF K=2 THEN V(1)=8
7145 IF K=3 THEN V(1)=11
7150 IF K=4 THEN V(1)=16
7155 IF K=5 THEN V(1)=22
7160 GOTO 360
7170 IF V(1)=2.8 THEN K=0
7175 IF V(1)=4 THEN K=1
7180 IF V(1)=5.6 THEN K=2
7185 IF V(1)=8 THEN K=3
7190 IF V(1)=11 THEN K=4
7195 IF V(1)=16 THEN K=5
7210 IF T(1)<5 THEN 7235
7215 IF K=0 THEN 380
7220  K=K-1
7225  T(1)=T(1)/2
7230 GOTO 7250
7235 IF K=5 THEN 380
7240  K=K+1
7245  T(1)=T(1)*2
7250 IF K=0 THEN V(1)=2.8
7255 IF K=1 THEN V(1)=4
7260 IF K=2 THEN V(1)=5.6
7265 IF K=3 THEN V(1)=8
7270 IF K=4 THEN V(1)=11
7275 IF K=5 THEN V(1)=16
7280 GOTO 360
```

age, developer used, etc., though the contrast-level information remains relatively constant.

Now the program is calibrated, and you are ready to use it for further printing. In use, the program is self-prompting and largely self-explanatory, so there should be little trouble in using it.

I have enjoyed writing this program, and using it has been a joy. I figure that after about 800 hours of printing this program will have paid for my system. There should be no problems in calibrating this program for use with darkroom setups different from mine. If you have trouble, send me a letter describing your problem and your setup (please enclose a stamped self-addressed envelope) and I'll try to help. ■

```
#RUN
FILM FORMATS:
1=35 M.M.
2=2 1/4 ^2
3=2 1/4 X 3 1/4
4=4 X 5
WHICH FORMAT WILL YOU BE
PRINTING (PLEASE TYPE A NUMBER
FROM ABOVE)? 1
DO YOU WANT THE PAPER GRADE
OPTION (0=NO,1=YES) ? 1
HIGHLIGHT DENSITY ? 1.35
SHADOW DENSITY ? .87
PRINT SIZE ? 6.333
EXPOSURE TIME = 29  SEC.
@F/5.6 .
CONTRAST GRADE = 2
ANOTHER PRINT (0=NO,1=YES)? 1
CONTROL COMMANDS ARE:
1=NONE(CTRL StATUS REMAINS QUO).
2=REPRINT NEG. AT NEW SIZE.
3=RESET CTRL STATUS.
CONTROL COMMAND ? 2
PRINT SIZE ? 12
EXPOSURE TIME = 26  SEC.
@F/2.8 .
CONTRAST GRADE = 2
ANOTHER PRINT (0=NO,1=YES)? 1
CONTROL COMMANDS ARE:
1=NONE(CTRL StATUS REMAINS QUO).
2=REPRINT NEG. AT NEW SIZE.
3=RESET CTRL STATUS.
CONTROL COMMAND ? 3
FILM FORMATS:
1=35 M.M.
2=2 1/4 ^2
3=2 1/4 X 3 1/4
4=4 X 5
WHICH FORMAT WILL YOU BE
PRINTING (PLEASE TYPE A NUMBER
FROM ABOVE)? 4
DO YOU WANT THE PAPER GRADE
OPTION (0=NO,1=YES) ? 0
HIGHLIGHT DENSITY ? 1. 60
PRINT SIZE ? 8
EXPOSURE TIME = 26  SEC.
@F/8 .
ANOTHER PRINT (0=NO,1=YES)? 1
CONTROL COMMAND ? 1
HIGHLIGHT DENSITY ? 1.34
PRINT SIZE ? 5
EXPOSURE TIME = 23  SEC.
@F/8 .
ANOTHER PRINT (0=NO,1=YES)? 0
I HOPE I WAS HELPFUL TO YOU.
SEE YA SOON.
STOP 0460
READY
#
```

Sample run.

Peripheral Interfacing

Specifically, this article tells you how you can inexpensively connect TTY (Teletype) or TTL (transistor-transistor logic) interfaces to the serial RS-232 port of your computer.

Rod Hallen
Road Runner Ranch
PO Box 73
Tombstone AZ 85638

Interfacing your personal computer to various peripheral devices is always an interesting proposition. All the microprocessors hobbyists commonly use are digital eight-bit parallel chips with instruction times of a microsecond or two. Peripheral devices can be analog as well as digital, serial as well as parallel, and their execution time is usually measured in milliseconds instead of microseconds.

Obviously, some kind of matching is needed. Unless your device includes the required matching, you'll have to provide it. This article is about some inexpensive and readily available interfaces that will help you tie TTY or TTL peripherals to your computer's serial RS-232 port.

RS-232 to TTY

I was recently asked by a friend to help him connect a Teletype Model 33 with a 20 mA loop current interface to his computer. I thought that this would be a simple job since most computers provide a serial port for just such a purpose. However, his serial port was RS-232 only. My next thought was to modify the port, which is easy enough to do. But my friend said no . . . he didn't want any modifications to his brand new computer.

As I was contemplating throwing together an RS-232 to 20 mA (and vice versa) adapter, I recalled the Electronic Systems RS-232-to-TTL converter that I had used (it had saved me over $200) in my Teletype Model 43. The same company also makes a kit for just the situation I was faced with now (see parts list).

I wrote for one, received it in six days, spent a total of four minutes putting it together and had the 33 working less than 30 minutes after the kit came out of the box.

The four-minute construction time doesn't include the extra five minutes I spent removing the 2N2222A transistor from the board and turning it around because I had inserted the leads backwards. The transistor outline on the circuit board is for the metal can variety with a tab to indicate orientation. The 2N2222A supplied with the kit has a plastic case, and no information is given to tell you which way to plug it in.

If I had traced a couple of leads on the bottom of the board first, I'd have known which way was which, but I was in too much of a hurry to show off. Fig. 1 displays the correct transistor orientation (schematics are courtesy of Electronic Systems).

The schematic drawing for the Electronic Systems RS-232 to 20 mA adapter is shown in Fig. 2. This also converts from 20 mA back to RS-232, and full duplex operation is possible since both directions are completely independent of each other. It is really a simple circuit that is built on a 1½ by 2½ inch glass board that can be tucked away just about anywhere.

RS-232 to TTL

Don't confuse TTL and TTY. TTL (transistor-transistor logic) is standard IC level where +5 volts equals a mark (1 or high) and ground equals a space (0 or low). TTY is short for Teletype, where 20 mA of current flowing is a mark and no current flowing is a space. Fig. 3 is the

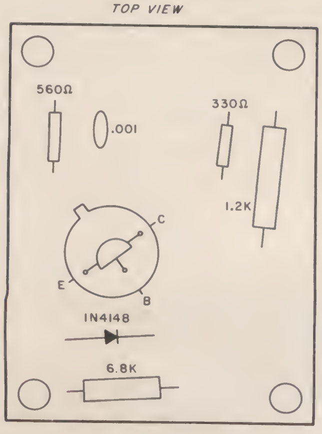


Fig. 1. Parts layout for the TTY adapter circuit board. The flat side of the plastic 2N2222A transistor faces away from the tab printed on the board.

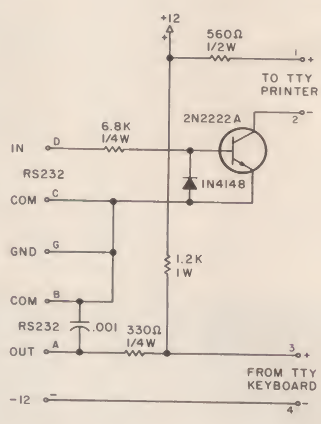


Fig. 2. The schematic diagram of the RS-232-to-TTY adapter. This is designed to interface the Teletype Model 33 and similar machines that require a 20 mA loop for operation.

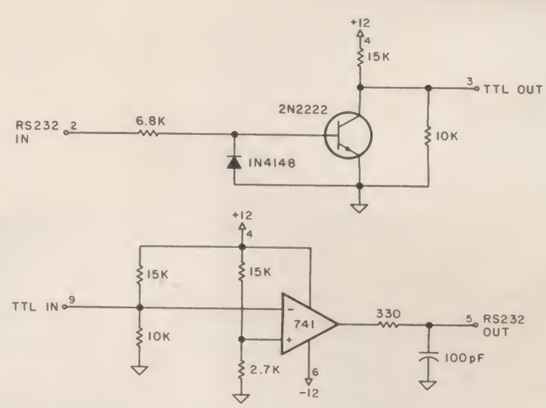


Fig. 3. The schematic of the RS-232-to-TTL converter. The +12 volts can be tapped off of your computer supply since the current requirements are very low.

schematic of the RS-232-to-TTL converter. Like the TTY adapter, this converter will also operate full duplex. I have been using it with my Model 43 for more than six months without any problems.

The board has a ten-contact edge, but rather than buy a connector I soldered wires directly to holes drilled in each contact. The TTL board is smaller than the TTY board but only because the latter provides mounting holes, while the former is designed to mount in an edge connector.

Conclusion

One important note: You can reverse the TTL board, but not the TTY board, to suit two different situations. This means that the TTL board will interface a serial TTL port to an RS-232 peripheral or an RS-232 port to a TTL peripheral. I'm using two now—one in each of the above cases.

The TTY board can be used to connect an RS-232 port to a 20 mA device (Model 33), but you can't use it to interface a 20 mA port to an RS-232 device. It was my intention to use one to connect my RS-232 terminal to a KIM-1 Teletype port, but it won't work that way.

The KIM output port is a closure to +5 volts, and the TTY board input is looking for a short. The TTY board output is a closure to +12 volts, and the KIM input port is looking for a short. I guess I'll have to homebrew that one myself.

Electronic Systems has many other kits available at reasonable prices. See their ads in most of the computer magazines or write them for a catalog. I am using a total of four of their kits and I'm considering their telephone line modem as one of my next projects. ■

TTY & RS-232 Interface	Kit	$7.00
	Bare Board	4.50
TTL & RS-232 Interface	Kit	7.00
	Bare Board	4.50
	Connector	2.00

Electronic Systems
PO Box 21638
San Jose CA 95151

Parts list.

KB CALENDAR

Indianapolis IN

The Central Indiana Section of IEEE and the corresponding IEEE Computer Society Chapter will sponsor its fourth annual IEEE Indy Microcomputer Show Thursday, June 28, 1979, 9:30 AM to 9:00 PM, Sheraton Motor Inn East, located at I-465 and SR-67, Indianapolis. There will be exhibits, demonstrations and technical seminars addressing the engineering, industrial, scientific, medical, business and personal applications of microcomputer systems.

Harry D. Bostic, Publicity Chairman, IEEE Indy Microcomputer Show, Naval Avionics Center, D/810, 6000 E. 21st St., Indianapolis IN 46218. (317) 353-3047, 3218.

St. Paul MN

Amateur Fair '79. Dakota Division's largest Swapfest and Exposition for Computer Hobbyists and Amateur Radio Operators will be held Saturday, June 2, at the Minnesota State Fairgrounds, St. Paul. Free overnight parking for self-contained campers, June 1 only. Talk-in on 16/76 and 52/52. Sell from your car in the giant flea market. Inside space available. Many great prizes. AMSAT and microprocessor exhibits. FCC, ARRL and Minnesota Repeater Council booths. Admission $2. For further information or reservations for commercial space, write Amateur Fair, PO Box 30054, St. Paul MN 55175.

Lexington VA

Introduction to Microcomputer Interfacing—A hands-on, short course, July 16 to 27, 1979. Tuition $395. Contact Prof. Philip Peters, Dept. of Physics, Virginia Military Institute, Lexington VA 24450, for further information and application forms.

Las Cruces NM

The American Association of Physics Teachers announces its first national meeting. Theme is the use of microcomputers in physics teaching. The meeting will be held at New Mexico State University, Las Cruces NM, June 19-23, 1979. In addition to the planned activities, many computer manufacturers have been invited to exhibit their products at the meeting and to hold workshops on the use of their equipment.

Readers who wish further information on the meeting, contact: American Association of Physics Teachers, Graduate Physics Building, SUNY at Stony Brook, Stony Brook NY 11794, Attn: Summer Meeting. (516) 246-6840.

New York NY

Twenty-five sessions during four days will make up the program of the 1979 National Computer Conference Personal Computing Festival in New York. The June 4-7 program at the Sheraton Center Hotel, 52nd St., between 7th Ave. and Ave. of the Americas, will consider applications of microcomputers to art, education, fun and profit. The festival also will feature demonstrations of personal computer innovations and commercial exhibits.

Additional information, including housing and registration procedures, is available from AFIPS, 210 Summit Ave., Montvale NJ 07645. (201) 391-9810.

Chicago IL

Papers are being solicited for the November 6, 1979, Third International Conference on Computer Software and Applications—COMPSAC 79—sponsored by the IEEE Computer Society. For additional information, contact the general chairman: Dr. William Smith, Executive Director, Toll Electronic Switching and Operator Services Division, Bell Laboratories, Naperville IL 60540. (312) 690-2389.

Santa Ana CA

Swap Meet sponsored by North Orange County Computer Club, Sunday, June 17, 9 AM till 5 PM, Advanced Computer Products—rear parking lot—1310-B East Edinger, Santa Ana CA 92705. Free to all buyers (open to general public). Sellers' rates, per parking lot space (approximately 160 sq. ft.): NOCCC Member, noncommercial—$2; nonmembers, noncommercial—$5; commercial—$10. Over 80 spaces are available—first come, first served. Send check to NOCCC Swap Meet, PO Box 3243, Orange CA 92665. Make check payable to NOCCC. Be sure to include your name, phone number(s), rate classification, number of spaces. NOCCC members, include your membership number.

For more information, contact Lorin S. Mohler, NOCCC Swap Meet chairman, 1391 W. Cerritos Ave. #69, Anaheim CA 92802. (714) 535-3339.

Chicago IL

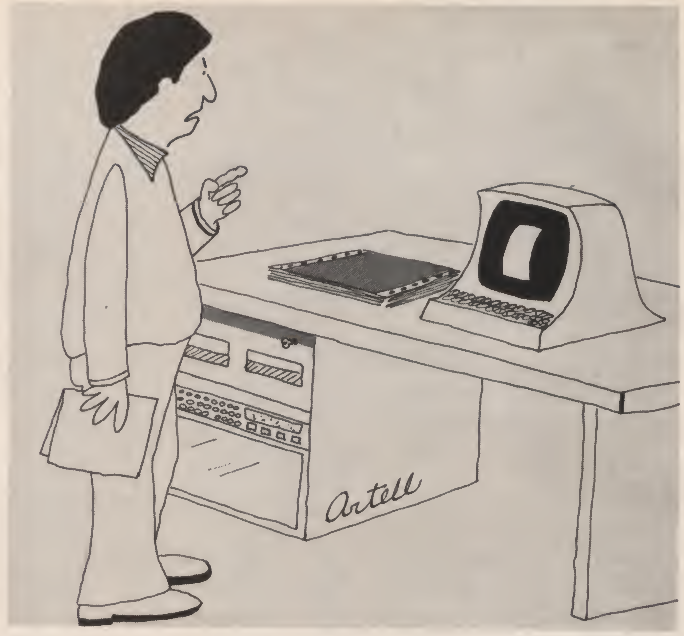
The Society for Management Information Systems has announced a "Forum on Information Resource Management" to be held at the Drake Hotel, Chicago, June 25-26, 1979. Major industry spokesmen have been invited to discuss technological innovations in information resource management and to address the outlook for systems managers during the 80s.

For further information, contact Ken Burroughs, DBD Systems, 1500 N. Beauregard St., Alexandria VA 22311. (703) 820-3310.

Kenosha WI

University of Wisconsin—Parkside Computer Fair III, Kenosha WI, Saturday, June 2, 1979, 9:00 AM to 4:00 PM. If you would like to participate in any way, give a call to Don Piele, UW-P Computer Fair III, University of Wisconsin—Parkside, Kenosha WI 53141, (414) 553-2327.

"Poly want a nomial . . . aawk. Hey, Einstein, you've got an error in that FOR-NEXT loop!"



"I'm tired of your more-logical-than-thou attitude!"

Reader Service—see page 179

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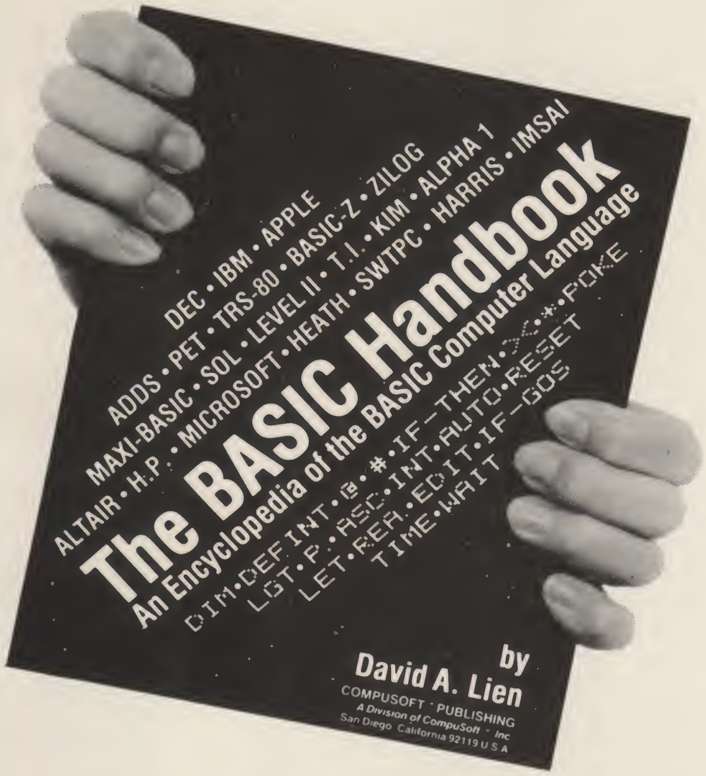

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From the author of the highly acclaimed TRS-80 Learner's Manual comes the book you've been asking for! THE BASIC HANDBOOK is THE definitive reference and "idea" book which explains in detail the BASIC language as used in over 50 micros, minis and mainframes.

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Reader Service—see page 179

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Kilobaud Classified advertisements are intended for use by persons desiring to buy, sell or trade used computer equipment or software. No commercial ads are accepted.

Two sizes of ads are available. The $5 box allows up to 5 lines of about 37 characters per line, including spaces and punctuation. The $10 box allows up to 10 lines. Minimize use of capital letters to save space. No special layouts allowed. Payment is required in advance with ad copy. We cannot bill or accept credit.

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TRS-80 quality Word Processor. Helps prepare letters, memos, documents and even a book. Level II, $25. DOS, $35. Poi Pow, 96 Dothan St., Arlington MA 02174.

Smoke Signal Broadcasting & SWTP owners: Software now available for Chieftain I & II microcomputer systems & SWTP 5" disk systems. Random accessing software: A/R Inven, $370; A/P, $270; P/R, $290; G/L, $290; F/A Inven system, $200. Application manuals are $20 each if purchased separately. Steve Chavez, 2920 Carlisle N.E., Albuquerque NM 87110.

TRS-80 Level II programs on cassette. 4K: Kaleidoscope game of Life! Three dimensional Lunar/Martian Lander! Destroy the Russian ICBM! 1 = $6, 2 = $11, 3 = $15. 16K: You name teams in College/Pro Football! Shoot down attacking Kamikazes! Battle Romulans with Star Trek! 1 = $9, 2 = $17, 3 = $24. R. Fitzgerald, 3338 Sheila Ln., #292, Dallas TX 75220.

For Sale: TRS-80 software technical manual covering Level II BASIC ROM, DOS BASIC RAM. Documents the use of all internal subroutines such as moves, floating math, I/O, graphics, functions (sin, exp) and more. Includes a program demonstrating their use. For more info. send SASE to Terry Smith, 16327 Cloverwick, Spring TX 77373.

H8 Owners: Save and restore disk files to and from cassette. Program tape and instructions, $15. Double media disks, $7.50. Karl K. Sidinger, 6967 W. Rancho Dr., Glendale AZ 85303.

TRS-80 Level II, 16K stock portfolio evaluation program. Keep up to date on your stocks, which broker to fire, etc. On tape, $6. R. W. Carney, 1927 S. Dewey, Bartlesville OK 74003.

TRS-80 Software: Business programs written in 16K Level II. Available for cassette or disk files. Send for list & prices. L Owens, Rt. 6, Box 336A, Thomasville GA 31792.

TRS-80 Yellow Page. A free catalog of software & hardware. For fast delivery, TRS-80 owners send 2 SASE envelopes and $1. Vendors send $20 & full prod. descrip. to share printing costs. Features business software & word processing. Write to: 96 Dothan St., Arlington MA 02174.

KISS is money making project via comp dating for schools, clubs. TRS-80 or any string BASIC 16K holds 400 surveys. (net $100+) List, doc., surveys, admin. instr. for $7. D. Bohlke, Coggon IA 52218.

Apple II Checkers, Tictactoe on cassette. Board shows all moves. Both for $10. Others. Send SASE for free list. Ed Dixon, Progress St., Florence SC 29501.

TRS-80 16K Level II programs on tape. Stock portfolio evaluation, $6. Itemized income tax deduction records, $5. Both for $8. Dick Carney, 1927 S. Dewey, Bartlesville OK 74033.

---

*Books of computer games in BASIC. ENIGMAS-1 ($8): Gone Fishing, Concentration, Starship, Craps, Slot-Machine, Sherlock Holmes, Tank Attack. ENIGMAS-2 ($8): Number Guess, Mortar Battle, In-Between, Shell Game, Safari, Starship-2, Dice Roll, Puzzle. *Catalog and test program Frog Race, $1. Available in Standard BASIC, SWTP 8K BASIC or Radio Shack TRS-80 BASIC. Please specify. B. Erikson, PO Box 11099, Chicago IL 60611.

KIM-1 Single Pass Editor Assembler. No add-on hardware or memory req'd. 150 lines off tape or 50 resident on std. KIM. add min. 340 & 120 respectively for each K of addit'l memory. MOSTech mnemonics, compatible label/var. 18 pg documentation delivered immed. Super fast, flexible, efficient economical. $6.50 check/money order to: T. Davis, 1521 Riverside Dr., Rainelle WV 25962.

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SWTP Owners: 4K memory boards, fully socketed, $60 each. Also KSR-33 Teletype, excellent condition, $325. Mike Price, 8127 E. Fremont Ave., Englewood CO 80112.

Sacrifice! Digital Group components: 1 34K system includes Z-80 CPU with keyboard, dual 8" floppies, printer, monitor and software. Also following individual items: 1 10K Z-80 CPU, 4 digital cassette drives with cabinet, keyboard. Make offer. Call (803) 552-5963 or write 7713 Linsley St., Charleston SC 29405. Will consider trade for other equipment, i.e., PET or TRS-80.

For Sale: Used floppy disks BASF, FLEXY DISK I (standard 8"). Guarantee low usage: recorded on once and played back only once. $3.50 each. T. Langel, PO Box 359, Forest Ranch CA 95942.

Seattle Computer Products 16K plus memory, $350; Tarbell disk controller, $255. Both are new, unused, factory assembled and tested. Glenn Nelson, 205 Meadows Rd., Whiteface MT 59937. (406) 862-3854.

You can make your TRS-80 run faster by speeding up the microprocessor (up to twice the speed). Send $25 for step by step instructions to J. Pawloski, 10932 Palma Vista, Garden Grove CA 92640.

TRS-80 Owners! Tired of endlessly thumbing through your Level II manual? Send $1 and a self-addressed, stamped envelope and receive a complete (over 275 entries!!) Level II Manual Index. You will not believe how much time this will save you. Send $1 and SASE to Dave Rose, 3439 Harding Ave., Hapeville GA 30354.

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SOL-20, DecWriter II printer, 52K, tape, extended cassette BASIC; over $4500 for $3000. Fred Petran, 4745 N. 158th St., Brookfield WI 53005. (414) 781-3494.

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TRS-80, 16K, Lev II, Expan. Intf. w/32K, one floppy dr, ed/asmblr, payroll, disk mail list, pers. finance, gen ledger, manuals. Paid over $2800—Sell $2300 + U pay 2 ship. T. Fritts, 4625 SE State, Bartlesvl OK 74003.

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Digital Group Z-80 system. 32K in beautifully matched cabinets by DG. Parallel IO, built to handle 64K memory. Includes CRT, keyboard, 4 PhiDeck cass. recorders and *note*: an unused DecWriter II Printer. Up & running except printer. All software including Business BASIC & documentation. Ideal for all applications. Price $5000. DeGraff Associates, PO Box 18640, Salt Lake City UT 84118. Phone (801) 966-1451.

For Sale: PDP8L Minicomputer, $600. PDP8L with BA08 mem ext. 8K and periph. adapter, $1200. Checked out with DEC diagnositics. Certified checks only. O. Glaser, 508 3rd St., West Roundup MT 59072. (406) 323-2339.

TRS-80 SOFTWARE DIRECTORY Over 800 programs are listed in a directory of TRS-80 software. Programs are listed by company and classification. The company name and address are given as well as the price. Over 125 companies are listed. Send $4 to: H. DiBlasi, Box 1664, Lake Havasu AZ 86403.

SWTP MP-A2 CPU board with SWTBUG, $95. 4K RAM boards, 350 ns low power, $65. AC-30 cassette interface, $50. Assembled, running, 1/3 less than kits. Bob Levine, 32 King St., New York 10014.

TRS-80 Users—Play Monopoly against your Level II, 16K TRS-80. Entire board, including playing pieces, houses, etc., is displayed. Send SASE for more information, or send $12.95 for the program on cassette. With the cassette you get an instruction booklet and a complete listing. Steven Sanders, 47-12 Jayson Avenue, Great Neck NY 11020.

Imsai 8080—CPU, dual serial I/O ports, 8K static RAM, 11 connectors. ASR-33 Teletype with paper tape rdr pnch. $1600. R. Levinson, 124 Nashoba Rd., Concord MA (617) 369-8471.

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Apple II or TI-58. Astronomy, hams, navigation. Sidereal time, H0-211, pi-net, cw kbd. Hard copy, $1 ea. R.A. planets—$3, C'stte, $6. SASE to W. Skeen, Rt. 1, Hornbrook CA 96044.

For Sale—6502 assembler program and hardware package to maximize the printing capabilities of your Diablo. So your Diablo will print bidirectional and at 45 cps. Complete with schematic for installation. Send $250 Certified Check to Wayne R. Cole, 409 Washington Ave., Suite 714, Towson MD 21204. Phone (301) 321-7797.

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For Sale: 50 pg users manual with source/assembly listings for KONVERSE, HOL interpreter and compiler for 6800 systems with MIKBUG. Derived from FORTH, similar to IPS, Jan. '79, *Byte*. Mach. code 2.5K, rest in HOL for 4K total. Source file editor & DOS interface included in extra 1.7K. $10 pp. R. Yost, 1825 E. Palo Verde Dr., Phoenix AZ 85016.

Quality TRS-80 Programs. Business, games, ham radio, Monopoly, Yahtzee, many more. Send SASE for information and complete list. Sandy Stange, Box 145, Lithonia GA 30058.

TRS-80 Software: Sales Analysis. Games; "Oil Baron" (16K Level II), Slot Machine & more. Will program to suit needs. Specify & send SASE to: P. Knechtel, S. 822 Ivory #2, Spokane WA 99202.

For Sale: 2 MHz 4K OSI memory board. Built at factory, burned in 500 hours, in good condition. With manual and shipping: $100. Everett Rubel, S.R. 90574, Fairbanks AK 99701.

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CORRECTIONS

As printed, the BASEDIT program in "An Editor for 6800 BASIC Programs" (January 1979, p. 22) sometimes resequences only part of a BASIC program. This happens if a GOTO statement is at the very end of a program and is not followed by the customary nulls or any other characters. Though this will not happen in normal use, it can be fixed by changing lines 03130 and 03610 as shown.

```
03130  0381  FE 02ED SLOOP8 LDX SAVESX
03610  03DB  7E 0381        JMP SLOOP8
```

Although BASEDIT worked just fine with SWTP 8K BASIC version 2.0, some people have had troubles reading the BASEDIT output tape because there is no delay after a carriage return/line feed, and their BASIC doesn't have enough time to store the line in memory. As a result, it sometimes garbles a line or drops it altogether. This may happen if their CPU clock speed is very slow or if their tape output has only one stop bit instead of two.

To fix this problem, change line 01240 as shown, and insert the patch given here. This patch fits into the monitor RAM on the CPU board, but is easily relocated anywhere in memory. It essentially inserts an extra delay after each line of the program.

```
change line 01240 to

01240 0209 BD A050          JSR GOSLOW
```

A version of BASEDIT for the SWTP mini-disk system is available from Lehigh Computer Works, 1132-2 Tilghman, Allentown PA 18102. Cost is $10, which includes source and object code on a diskette, instructions, postage and handling. A Percom disk version is available through Percom, 318 Barnes, Garland TX 75042.

```
A050 36       GOSLOW PSH A           SAVE THE CHARACTER
A051 BD E1D1         JSR   OUTEEE    PRINT IT
A054 32              PUL A
A055 81 0A           CMP A $0A      CHECK FOR LINE FEED
A057 26 0E           BNE   EXIT      IF NOT, EXIT
A059 FF A070         STX   SAVEX
A05C 86 05           LDA A $05      SET UP TIME DELAY
A05E 09       WAIT   DEX
A05F 26 FD           BNE   WAIT
A061 4A              DEC A
A062 26 FA           BNE   WAIT
A064 FE A070         LDX   SAVEX
A067 39       EXIT   RTS
A070          SAVEX  RMB 2
```

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✓ Reader Service—see page 179

✓ Reader Service—see page 179

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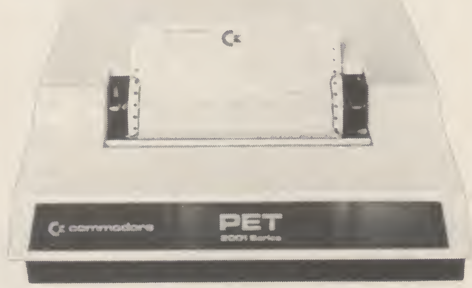

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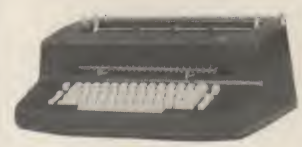

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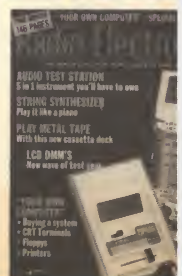

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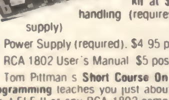

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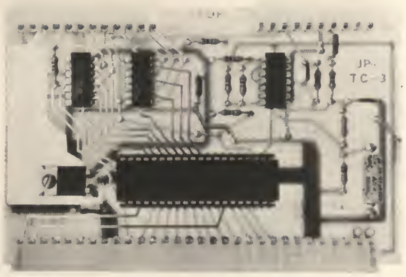

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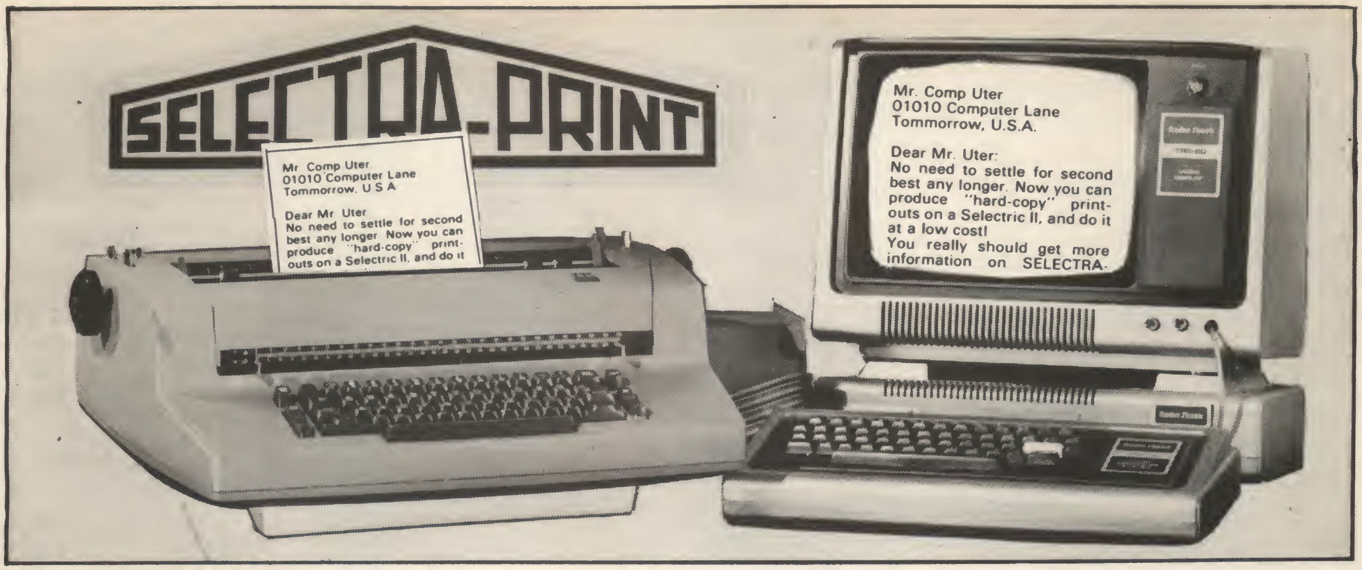

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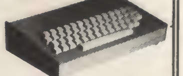

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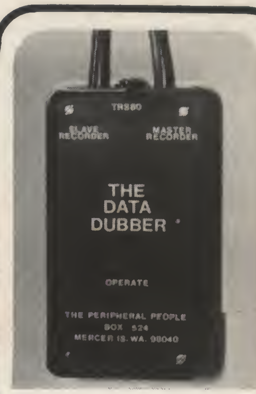

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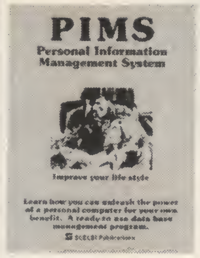

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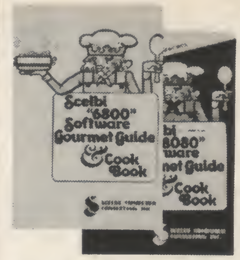

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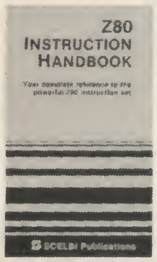

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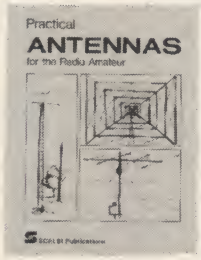

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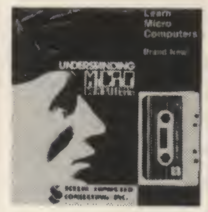

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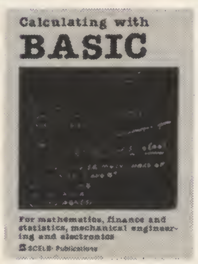

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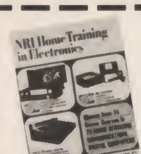

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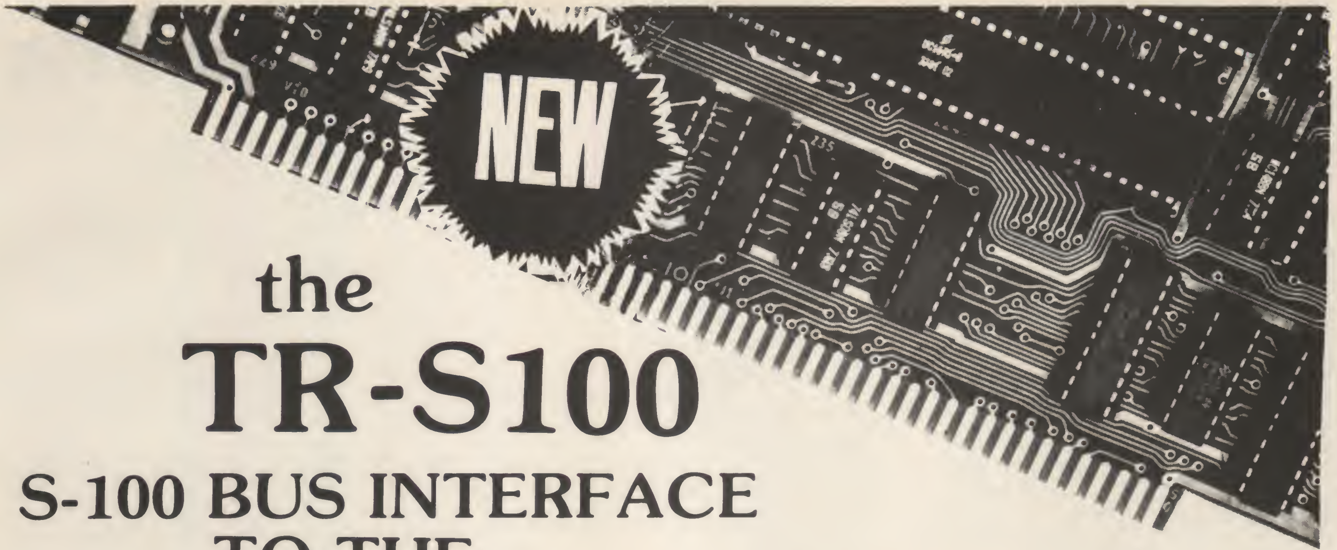

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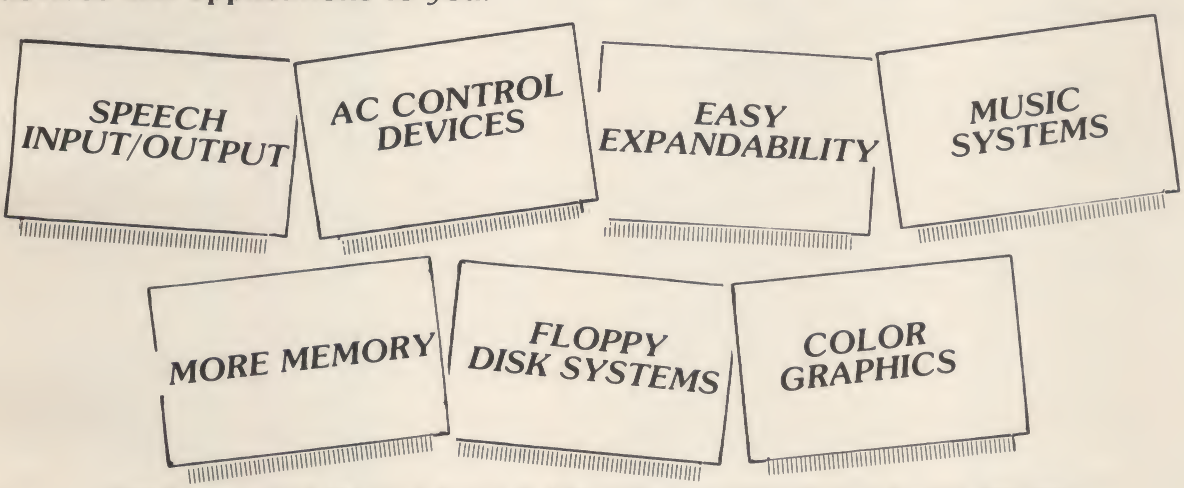

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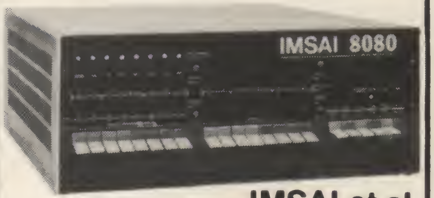

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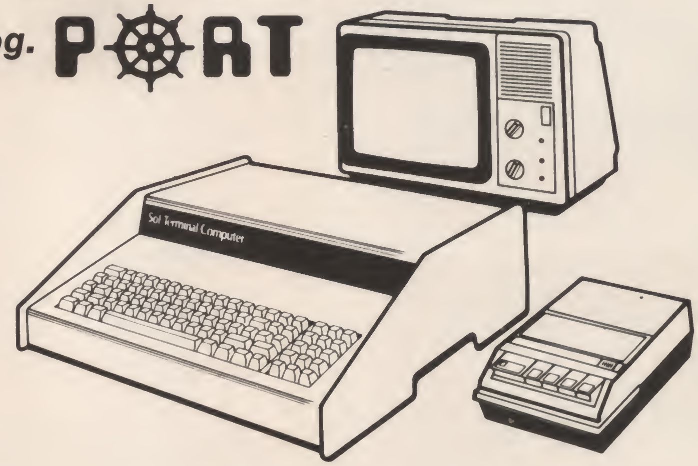

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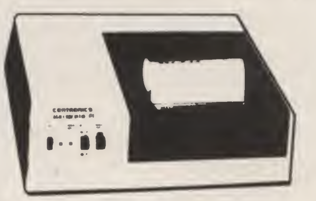

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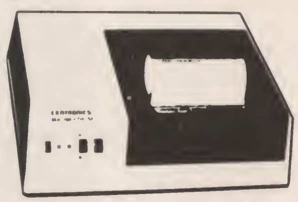

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PERS2 initializes Payroll File. Adds and Updates Payroll Records.

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PERS5 prints Job Cost Report, quarterly 941 run, Annual W-2 run.

PERS6 lists one Employee's History. Lists all Employees' Histories.

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LEDGER2—sets up and updates JOURNAL Transaction file.

LEDGER3—lists both JOURNAL and CHART of ACCOUNTS files.

LEDGER4—does TRIAL BALANCE and POSTING. It outputs an AUDIT TRAIL of all transactions.

LEDGER5—produces PROFIT and LOSS STATEMENT.

LEDGER6—produces BALANCE SHEET. Assets, liabilities and owners' equities are shown by account and by totals.

ACC'TS PAYABLE

PAY1 initializes A/P and adds records to Transaction file.

PAY2—changes or deletes Transaction and Master records.

PAY3—reports outstanding A/P broken down into four categories: under 30 days, 31-60 days, 61-90 days, over 90 days.

PAY4—reports all outstanding A/P for a single customer or all customers, followed by Cash Requirements.

PAY5—reports all outstanding A/P for a single date or a range of dates followed by Cash Requirements.

PAY6—lists both the Transaction and the Master files.

PAY7—PRINTs checks and accumulates and journalizes A/P (creates entries into the MICROLEDGER's JOURNAL file).

ACC'TS RECEIVABLE

REC1—initializes A/R, adds A/R records & PRINTs invoices.

REC2—enters receipt of customer payments, changes or deletes Transaction & Master records.

REC3—reports outstanding A/R broken down into four categories: under 30 days, 31-60 days, 61-90 days, over 90 days.

REC4—produces statements of A/R for a single customer or for all customers followed by Cash Projection.

REC5—produces a report of all A/R outstanding for a single date or a range of dates, followed by Cash Projection.

REC6—lists Transaction & Master files, and accumulates & journalizes A/R (creates entries into MICROLEDGER's JOURNAL file).

INVENTORY CONTROL

INV1—initializes both Transaction and Master files, adds & updates Transaction and Master records; initializes JOURNAL file, restarts Master file.

INV2—runs, issues or receives Transactions, creating inventory records. It also journalizes and accumulates Transactions (creates entries into MICROLEDGER's JOURNAL file).

INV3—lists both Transactions and Master files.

INV4—supplies Stock Analysis Report, and the ABC Analysis.

INV5—produces the report showing allocation of all materials used year-to-date by JOB Control Classification codes.

INV6—computes and provides the E.O.Q. (Economic Order Quantity).

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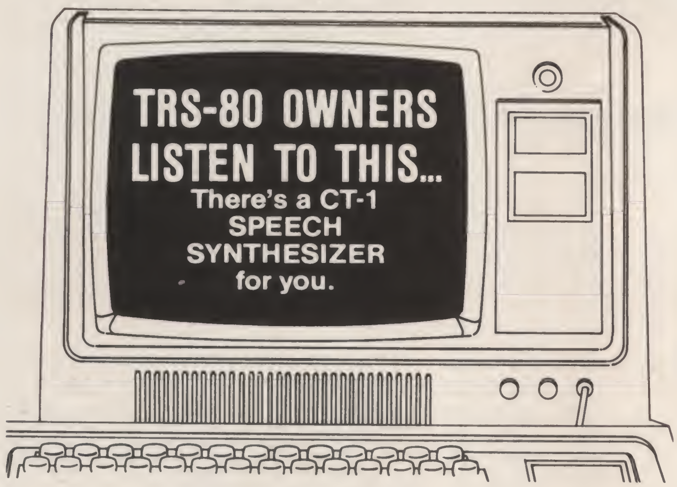

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INVENTORY - Complete file maintenance plus selective reporting by field. Reorder report of critical parts. Point of Sales generates sales slips and refund slips, updates the inventory file, sets up accounts receivables record for the customer who charges--all done immediately. List prices may be overridden. Appropriate accounting is done. The inventory file can contain over 1100 records.

ACCOUNTS RECEIVABLES - Complete file maintenance plus selective reporting by field. Receipt of payments by customer or invoice. Monthly billing and aged invoices. Appropriate accounting is automatic. Complete customer file maintenance.

ACCOUNTS PAYABLES - Complete file maintenance plus selective reporting by field. Report of invoices currently payable by user entered date. Ability to put an invoice on hold so that it will not be paid. Checks are printed on a user defined format. Check approval process before checks and Check Register are printed. Ability to enter manual checks. Appropriate accounting is done. Cycle and Net terms can be used.

GENERAL LEDGER - Complete account file maintenance allows all accounts to be user defined. Journal entries are easily made. The General Ledger, Balance Sheet, and Income Statement are printed using user defined accounts and titles. The General Ledger has 4 levels of totals.

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All key fields are validated for correctness as they are entered. Such data as the vendor number, customer number, account number, part number and invoice numbers are checked immediately against their own file.

The minimum hardware needed is 48K, 2 disks, a 132-column printer with either of Apple's interface cards (Parallel or Serial), and Applesoft II ROM card.

The FMS can be purchased at all fine computer stores as a package for $800.00 or by individual modules for $200.00 each. Manuals are available for $10.00 which is refundable when software is purchased.

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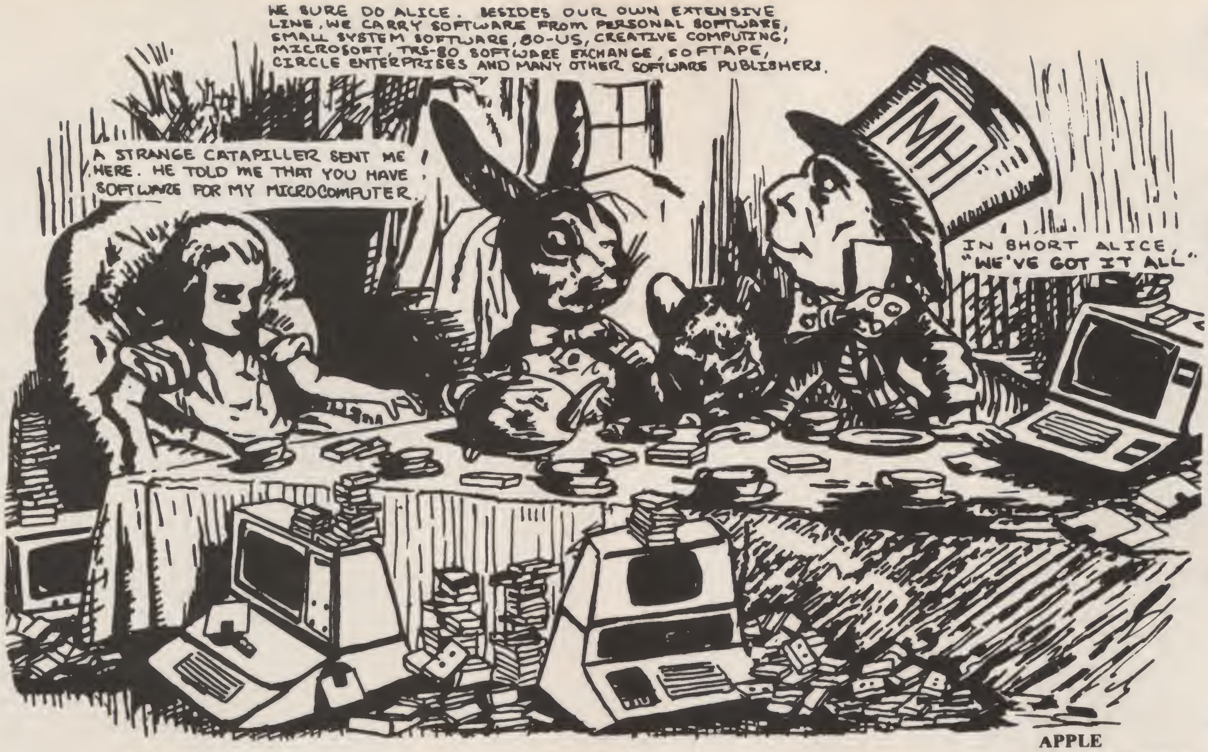

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✓ Reader Service—see page 179

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RCA Cosmac Super Elf Computer $106.95

Compare features before you decide to buy any other computer. There is no other computer on the market today that has all the desirable benefits of the **Super Elf** for so little money. The Super Elf is a small single board computer that does many **big** things. It is an excellent computer for training and for learning programming with its machine language and yet it is easily **expanded** with **additional memory, Tiny Basic, ASCII Keyboards, video character generation, etc.**

The **Super Elf** includes a **ROM** monitor for program loading, editing and execution with **SINGLE STEP for program debugging** which is not included in others at the same price. With **SINGLE STEP** you can see the microprocessor chip operating with the **unique Quest** address and data bus displays **before, during** and **after** executing instructions. Also, CPU mode and instruction cycle are decoded and displayed on eight LED indicator lamps.

An RCA 1861 **video graphics** chip allows you to connect to your own TV with an inexpensive video modulator to do graphics and games. There is a **speaker system** included for writing your own music or using many music programs already written. The speaker amplifier may also be used to drive relays for control purposes.

A 24 key **HEX keyboard** includes 16 HEX keys plus **load, reset, run, wait, input, memory protect, monitor select** and **single step**. Large, on board displays provide output and optional **high and low address**. There is a 44 pin standard connector for PC cards and a 50 pin connector for the **Quest Super Expansion Board**. Power supply and sockets for **all** IC's are included in the price plus a detailed 127 pg. instruction manual which now includes over 40 pgs. of software info. including a series of lessons to help get you started and a music program and graphics target game.

Many schools and universities are using the Super Elf as a course of study. OEM's use it for training and research and development.

Remember, other computers only offer Super Elf features at additional cost or not at all. **Compare before you buy. Super Elf Kit $106.95, High address option $8.95, Low address option $9.95. Custom Cabinet** with drilled and labelled plexiglass front panel **$24.95. NiCad Battery Memory Saver Kit $6.95.** All kits and options also come completely assembled and tested.

Questdata, a 12 page monthly software publication for 1802 computer users is available by subscription for $12.00 per year.

Tiny Basic for ANY 1802 System

Cassette $10.00. On ROM $38.00. Super Elf owners, 30% off. **Object code listing with manual $5.00. Object list, manual and paper tape $10.00. Original ELF Kit Board $14.95.**

Super Expansion Board with Cassette Interface $89.95

This is truly an astounding value! This board has been designed to allow **you** to decide how you want it optioned. **The Super Expansion Board comes with 4K of low power RAM** fully addressable anywhere in 64K with built-in memory protect and a **cassette interface**. Provisions have been made for all other options on the same board and it fits neatly into the hardwood cabinet alongside the **Super Elf**. The board includes slots for up to 6K of **EPROM** (2708, 2758, 2716 or TI 2716) and is **fully socketed.** EPROM can be used for tbe monitor and Tiny Basic or other purposes.

A 1K Super ROM Monitor $19.95 is available as an on board option in 2708 EPROM which has been preprogrammed with a program loader/editor and error checking multi file cassette read/write software, (relocatible cassette file) another exclusive from Quest. It includes register save and readout, block move capability and video graphics driver with blinking cursor. Break points can be used with the register save feature to isolate program bugs quickly, then follow with single step. The Super Monitor is written with subroutines allowing users to take advantage of monitor functions simply by calling them up.

Improvements and revisions are easily done with the monitor. If you have the **Super Expansion Board** and **Super Monitor** the monitor is up and running at the push of a button.

Other on board options include **Parallel Input and Output Ports** with **full handshake.** They allow easy connection of an ASCII keyboard to the input port. **RS 232 and 20 ma Current Loop** for teletype or other device are on board and if you need more memory there are two **S-100** slots for static RAM or video boards. A Godbout 8K RAM board is available for $135.00. Also a 1K Super Monitor version 2 with video driver for full capability display with Tiny Basic and a video interface board. **Parallel I/O Ports $9.85, RS 232 $4.50, TTY 20 ma I/F $1.95, S-100 $4.50.** A **50 pin connector set** with ribbon cable is available at $12.50 for easy connection between the **Super Elf** and the **Super Expansion Board.**

The **Power Supply Kit** for the Super Expansion Board is a 5 amp supply with multiple positive and negative voltages $29.95. Add $4.00 for shipping. Prepunched frame $5.00. Case $10.00. Add $1.50 for shipping.

INTEGRATED CIRCUITS

7400TTL

7400N	.17
7402N	.17
7404N	.19
7409N	.23
7410N	.17
7414N	.63
7420N	.17
7422N	1.39
7430N	.20
7442N	.50
7445N	.69
7447N	.60
7448N	.69
7450N	.17
7474N	.29
7475N	.49
7485N	.88
7489N	2.00
7490N	.43
7492N	.43
7493N	.43
7495N	.69
74100N	.90
74107N	.29
74121N	.34
74123N	.59
74125N	.39
74145N	.69
74150N	.95
74151N	.69
74154N	1.00
74157N	.69
74161N	.87
74162N	.87
74163N	.87
74174N	.96
74175N	.90
74190N	1.15
74192N	.87
74193N	.85
74221N	1.55
74298N	1.65
74365N	.66
74366N	.66
74367N	.66

74LS00 TTL

74LS00N	.25
74LS02N	.25
74LS04N	.25
74LS05N	.25
74LS08N	.25
74LS10N	.25
74LS13N	.40
74LS14N	.90
74LS20N	.25
74LS22N	.25
74LS28N	.41
74LS30N	.25
74LS33N	.39
74LS38N	.30
74LS74N	.70
74LS75N	.47
74LS90N	.51
74LS93N	.51
74LS95N	1.89
74LS107N	.35
74LS112N	.35
74LS113N	.35
74LS132N	.72
74LS136N	.35
74LS151N	.67
74LS155N	.67
74LS157N	.67
74LS162N	.91
74LS163N	.91
74LS174N	.95
74LS190N	1.06
74LS221N	1.95
74LS258N	.67
74LS367N	1.35

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LM305H	.87
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LM308N	.89
LM309H	1.15
LM309K	1.50
LM311H/N	.90
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LM318	1.35
LM320K-5	1.20
LM323K-5	6.95
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LM320K-15	1.35
LM320T-5	1.35
LM320T-8	1.60
LM320T-12	1.50
LM320T-15	1.60
LM324N	1.15
LM339N	1.55
LM340K-5	1.35
LM340K-8	1.35
LM340K-12	1.35
LM340K-15	1.35
LM340K-24	1.35
LM340T-5	1.25
LM340T-8	1.25
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LM703H	.40
LM709H	.28
LM723H/N	.50
LM733N	.67
LM741CH	.35
LM741N	.25
LM747H/N	.62
LM748N	.35
LM1303N	.82
LM1304	1.10
LM1305	1.27
LM1307	2.00
LM1310	2.75
LM1458	.47
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LM1812	7.50
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LM2902	1.50
LM3900N	.60
LM3905	1.75
LM3909N	.61
MC1458V	.50
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NE550N	.65
NE555V	.43
NE556A	.79
NE565A	1.00
NE566V	1.50
NE567V	1.20
NE570B	5.00
NE571B	5.00
78L05	.60
78L08	.60
79L05	.70
78M05	.85
75108	1.75
75491CN	.50
75492CN	.55
75494CN	.89

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CD4000	.16
CD4001	.21
CD4002	.21
CD4006	1.10
CD4007	.21
CD4008	.21
CD4009	.39
CD4010	.39
CD4011	.21
CD4012	.21
CD4013	.36
CD4014	.86
CD4015	.86
CD4016	.36
CD4017	.94
CD4018	.94
CD4019	.21
CD4020	1.02
CD4021	1.02
CD4022	.86
CD4023	.21
CD4024	.75
CD4025	.21
CD4026	1.51
CD4027	.36
CD4028	.79
CD4029	1.02
CD4030	.21
CD4035	1.02
CD4040	1.02
CD4042	.71
CD4043	63
CD4044	63
CD4046	1.67
CD4049	.36
CD4050	.36
CD4051	1.13
CD4060	1.42
CD4066	.71
CD4068	.40
CD4069	.40
CD4070	40
CD4071	.21
CD4072	.21
CD4073	.21
CD4075	.21
CD4076	1.75
CD4078	40
CD4081	21
CD4082	.21
CD4116	.47
CD4490	5.50
CD4507	1.00
CD4508	4.25
CD4510	1.02
CD4511	.94
CD4515	2.52
CD4516	1.10
CD4518	1.02
CD4520	1.02
CD4527	1.51
CD4528	.79
CD4553	3.50
CD4566	2.25
CD4583	4.50
CD4585	1.10
CD40192	3.00
74C00	.28
74C04	.33
74C10	.28
74C14	2.10
74C20	.28
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74C74	.75
74C76	1.40
74C90	1.15
74C93	1.40
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74C175	1.35
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74C923	5.50
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8096	.65
8097	.65
8098	.65
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8T10	4 50
8T13	3.00
8T20	5.50
8T23	3.10
8T24	3 50
8T25	3.20
8T26	1.69
8T28	2.75
8T97	1 69
8T98	1.69

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2101-1	3.95
2102-1	95
2102AL-4	1 60
21L02-1	1.18
21F02	1.25
2104A-4	4 95
2107B	4 95
2111-1	3.75
2112-2	3 95
2114L-3	7 90
4116	10.95
2513B	6.30
MM5262	40
MM5280	3 00
MM5320	9.95
MM5330	5 94
PD411D-3	4 00
PD411D-4	5.00
P5101L	13 95
4200A	9 95
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HD0165-5	6 95
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MCM6571A	9 95
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MM5312	4 80
MM5313	3 60
MM5314	3.90
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MM5318	3 60
MM5369	2.10
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8214	8 00
8216	2.90
8224	2 90
8228	5 35
8251	8 50
8253	10 00
8255	9 25
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CDP1861	12.95
6820	9 95
6850	12.95
6502	12.50

IC SOCKETS
Solder Tin Low Profile

PIN	1 UP	PIN	1UP
8	.15	22	.30
14	.18	24	.35
16	.20	28	.42
18	27	36	.58
20	.29	40	.57

3 level wire wrap gold
14 pin 25
2 level 14 pin ww 20

WIRE WRAP LEVEL 3

PIN		PIN	
14	.25	24	.86
16	.33	28	1.00
18	.57	40	1.23

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AY5-1014	7.50
3341	6.95

PROM

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N82S23	2 95
N82S123	3.50
N82S126	3.75
N82S129	3.75
N82S131	3.75
N82S136	8.75
N82S137	8.75
2708	10.50
DM8577	2 90
8223	2.90
2716T1	29 50
2716 Intel	48.00

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1.8432 MHz	4.50
3.5795 MHz	1 20
2.0100 MHz	1.95
2.097152 MHz	4 50
2.4576 MHz	4.50
3.2768 MHz	4.50
5.0688 MHz	4.50
5.185 MHz	4.50
5.7143 MHz	4.50
6.5536 MHz	4.50
14 31818 MHz	4.25
18 432 MHz	4.50
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AY5-3600	13 50
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74C923	5.50
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	1	10
Red	.55	.47
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Keyer 8043 14.50
comp w/spec./sock.

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2N2222A	.18
2N2369	.30
2N2904A	.20
2N2907A	.25
2N3053	.40
2N3638	.25
2N3643	.25
2N3904	.18
2N3906	.18
2N3055	.69
2N4400	.25
2N4401	.75
2N4402	.20
TIP31	.60
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DE9S	1.95
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DA15S	3.10

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DL704	CC	.300	1.25
DL707/DL707R	CA	.300	1.00
DL727/728	CA/CC	.500	1.90
DL747/750	CA/CC	.600	1.95
DL750	CC	.600	1.95
FND359	CC	.357	.70
FND500/507	CC/CA	.500	1.35
FND503/510	CC/CA	.500	.90
FND800/807	CC/CA	.800	2.20
3 digit Bubble			60
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DG8 Fluorescent			1.75
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7520 Clairex photocells			.39
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6100		40V	3.00
6100		50V	3 00
7700		50V	2.50
8000		55V	2.50
9400		65V	3.00
10000		20V	2.50
12000		30V	3.50
35000		25V	5.00
55000		25V	5.00
82000		15V	6.00
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6502 based single board with full ASCII keyboard and 20 column thermal printer. 20 char. alphanumeric display, ROM monitor, fully expandable. $375.00. 4K version $450.00. 4K Assembler $85.00, 8K Basic Interpreter $100.00. Power supply assembled in case $60.00.

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8v 5 amp, ±18v .5 amp, 5v 1.5 amp, −5v .5 amp, 12v .5 amp, −12 option. ±5v, ±12v are regulated. Kit $29.95. Kit with punched frame $34.95. Woodgrain case $10.00.

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Convert your TV set into a high quality monitor without affecting normal usage. Complete kit with full instructions.

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S-100 Computer Boards

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24K Static RAM Kit	423.00
32K Dynamic RAM Kit	310.00
64K Dynamic RAM Kit	470.00
8K/16K Eprom Kit (less PROMS)	**$89.00**
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EVERYTHING FOR THE S-100 BUSS

* **FPB-1** FRONT PANEL BOARD
  Hex Displays, IMSAI Replaceable $54.95
* **FDC-1** FLOPPY DISC CONTROLLER BOARD
  Controls up to 8 Discs $45.00
* **MEM-1A** 8K BYTE 2102 RAM Board $31.95
* **MEM-2** 16K BYTE 2114 RAM Board $31.95
* **CPU-1** 8080A CPU Board
  With Vector Interrupt $31.95
* **EPM-1** 4K BYTE 1702A EPROM $29.95
* **EPM-2** 16K or 32K BYTE EPROM
  2708 or 2176 interchangeable $30.00,
* **QMB-9** 9 SLOT MOTHER BOARD
  Terminated $35.00
* **QMB-12** 12 SLOT MOTHER BOARD
  Terminated $40.00
* **RTC** REALTIME CLOCK
  Programmable Interrupts $27.95

FUTURE PRODUCTS: 80 CHARACTER VIDEO BOARD,
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WMC inc. WAMECO INC. 111 GLENN WAY #8, BELMONT, CA 94002 (415) 592-6141

CALIFORNIA COMPUTER SYSTEMS

16K RAM BOARD. Fully buffered addressable in 4K blocks. IEEE standard for bank addressing 2114's
PCBD $26.95
Kit 450 ....$259.95

PT-1 PROTO BOARD. Over 2,600 holes 4" regulators. All S-100 buss functions labeled, gold fingers.
PCBD $29.95

PT-2 PROTO BOARD. Similar to PT-1 except set-up to handle solder tail sockets.
PCBD $29.95

SSM
FORMERLY CYBERCOM/SOLID STATE MUSIC.

PB-1 2708 & 2716 Programming Board with provisions for 4K or 8K EPROM. No external supplies require textool sockets. Kit $124.95

CB-1 8080 Processor Board. 2K of PROM 256 BYTE RAM power on/rest Vector Jump Parallel port with status Kit ....$119.00 PCBD $30.95

MB-6B Basic 8KX8 ram uses 2102 type rams, S-100 buss. Kit 450 NSEC.......$139.95 PCBD.......$26.95

MB-7 16KX8, Static RAM uses μP410 Protection, fully buffered Kit..............$299.95

MB-8A 2708 EROM Board, S-100, 8K8X or 16Kx8 kit without PROMS $75.00 ....PCBD $28.95

MB-9 4KX8 RAM/PROM Board uses 2112 RAMS or 82S129 PROM kit without RAMS or PROMS $72.00

IO-2 S-100 8 bit parallel /IO port, ⅔ of boards is for kludging. Kit ....$46.00 PCBD......... $26.95

IO-4 Two serial I/O ports with full handshaking 20/60 ma current loop: Two parallel I/O ports.
Kit ....$130.00 PCBD.............. $26.95

VB-1B 64 x 16 video board, upper lower case Greek, composite and parallel video with software, S-100.
Kit..............$125.00 PCBD..............$26.95

Altair Compatible Mother Board, 11 x 11½ x ⅛".
Board only ......$39.95. With 15 connectors......$94.95

Extended Board full size. Board only ....$ 9.49
With connector $13.45

SP-1 Synthesizer Board S-100
PCBD.............. $42.95 KIT..............$135.95

WMC inc. WAMECO INC.

FDC-1 FLOPPY CONTROLLER BOARD will drive shugart, pertek, remic 5" & 8" drives up to 8 drives, on board PROM with power boot up, will operate with CPM (not included).
PCBD $42.95

FPB-1 Front Panel. IMSAI size, hex displays. Byte, or instruction single step.
PCBD $47.50

MEM-1 8KX8 fully buffered, S-100, uses 2102 type rams. PCBD $25.95

QM-12 MOTHER BOARD, 13 slot, terminated, S-100 board only $34.95

CPU-1 8080A Processor board S-100 with 8 level vector interrupt PCBD $26.95

RTC-1 Realtime clock board. Two independent interrupts. Software programmable. PCBD $23.95

EPM-1 1702A 4K Eprom card PCBD $25.95

EPM-2 2708/2716 16K/32K
EPROM CARD PCBD $25.95

QM-9 MOTHER BOARD, Short Version of QM-12.
9 Slots PCBD $30.95

MEM-2 16K x 8 Fully Buffered
2114 Board PCBD $26.95

8080A	$9.95	2114 (450 NS) low pwr	$7.25
8212	2.49	2114 (250 NS) low pwr	7.99
8214	4.49	2102A-2L	1.50
8224	3.49	2102A-4L	1.20
8708	9.49	1702A-6	4.50
5101-1P	6.90	1702A INTEL (not prime)	4.00
5101-8P	8.40	4116	8/89.95

MIKOS

M39 **(415) 592-1800**
P. O. Box 424 • San Carlos, California 94070

Please send for IC, Xistor
and Computer parts list

JUNE SPECIAL SALE ON PREPAID ORDERS
(charge cards not included on this offer)

5% OFF ON WAMECO PCBD's
MIKOS PARTS ASSORTMENT
WITH BOARDS AND
CCS COMPUTER PRODUCTS
(ssm not included)

MIKOS PARTS ASSORTMENT WITH WAMECO AND CYBERCOM PCBDS

MEM-2 with MIKOS #7 16K ram
with L2114 450 NSEC $235.95

MEM-2 with MIKOS #13 16K ram
with L2114 250 NSEC $269.95

MEM-1 with MIKOS #1 450 NSEC 8K
RAM $119.95

CPU-1 with MIKOS #2 8080A CPU $94.95

MEM-1 with MIKOS #3 250 NSEC 8K
RAM $144.95

QM-12 with MIKOS #4 13 slot mother
board $89.95

RTC-1 with MIKOS #5 real time clock $54.95

VB-1B with MIKOS #6 video board less
molex connectors $99.95

EMP-1 with MIKOS #10 4K 1702 less
EPROMS $49.95

EPM-2 with MIKOS #11 16-32K EPROMS
less EPROMS $59.95

QM-9 with MIKOS #12 *9 slot mother*
board $79.95

FPB-1 with MIKOS #14 all parts
for front panel $134.95

MIKOS PARTS ASSORTMENTS ARE ALL FACTORY PRIME PARTS. KITS INCLUDE ALL PARTS LISTED AS REQUIRED FOR THE COMPLETE KIT LESS PARTS LISTED. ALL SOCKETS INCLUDED.

VISA or MASTERCHARGE. Send account number, interbank number, expiration date and sign your order. Approx. postage will be added. Check or money order will be sent post paid in U.S. If you are not a regular customer, please use charge, cashier's check or postal money order. Otherwise there will be a two-week delay for checks to clear. Calif. residents add 6% tax. Money back 30 day guarantee. We cannot accept returned IC's that have been soldered to. Prices subject to change without notice. **$10 minimum order. $1.50 service charge on orders less than $10.00.**

Reader Service—see page 179

10-DAY FREE TRIAL

Send for our FREE Catalog

NCE COMPUMART'S PET WAREHOUSE

We have more PETs than anyone, call for quick delivery.

AS LOW AS $595

4K - Keyboard C	$ 595
8K - Keyboard C	$ 795
16K - Keyboard B	$ 995
16K - Keyboard N	$ 995
32K - Keyboard C	$1195
32K - Keyboard B	$1195
32K - Keyboard N	$1195

C — calculator keyboard (only version with tape deck)
B — large business keyboard without graphics symbols
N — large keyboard with graphics symbols

PET ACCESSORIES

Commodore Dual Floppy Disk Drive	$1295.00
New! PET Terminal Package	$69.00
Second Cassette — from Commodore	$95.00
Commodore PET Service Kit	$30.00
Beeper - Tells when tape is loaded	$24.95
Petunia - Play music from PET	$29.95
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New Serial Printer Interface for PET	$79.95
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Betsi 4-slot S-100 Motherboard	$160.00
S-100 PET Interface was $289.00 SALE	$99.00

SAVE UP TO $100 ON READER/PUNCH

Our reconditioned paper tape Reader/Punches are reliable performers and now for a limited time they're all on sale! The serial Reader/Punch which was $950 is sale priced at $850. The Reader/Punch alone is marked down from $175 to $157, prices with interface follow:

Interface Model	Interface Added	Interface and Power	Interface, Power and Enclosure
Serial	$472	$616	$850
Parallel	$355	$598	$675

EXIDY SORCERER for $895

- Z-80 Processor
- Full-size ASCII keyboard
- User definable characters
- Up to 32K on-board RAM
- Interchangeable ROM PACs
- 30 x 64 display
- Resident 4K Monitor ROM
- Dual Cassette I/O
- Serial and Parallel I/O
- Complete Operators Manual
- Only $895

Top value in our catalog, simply add a monitor and tape decks to complete the system. Can be used as a terminal. Later ROM PACs will offer Z-80 Assembly Language, APL, PILOT, Word Processing and a DOS PAC for disk-based FORTRAN and COBOL. What a system for $895

Sorcerer 8K	$895
Sorcerer 16K	$1150
Sorcerer 32K	$1395
16K Expansion	$299

apple II

$200 FREE ACCESSORIES

Buy a 48K Apple II, mention this ad and take $200 in accessories free (if ordered together). This offer is good for $150 on 32K and $100 on 16K Apple II's. Now you can enjoy more of the best for less.

16K Apple II — $1195 (take $100 in free accessories)
32K Apple II — $1345 (take $150 in free accessories)
48K Apple II — $1495 (take $200 in free accessories)

Apple II Accessories

Disk and Controller	$595
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Parallel Printer Card	$180
Communications Card	$225
Hi-Speed Serial Card	$195
Firmware Card	$200
Hobby/Proto Card	$24
Microverter RF Mod.	$35
Sanyo M2544 Recorder	$55

SPECIAL OF THE MONTH

NEW PET TERMINAL OPTION

FREE

- Get a PET & a terminal in one
- Data rates to 2400 baud
- Full Duplex operation
- Auto line wrap-around
- With or without auto line-feed

Buy any model PET & get a free NCE PET terminal option, normally $69. Now your PET can handle two different jobs. You can use the PET for a powerful BASIC computer or you can load our machine-code program to use the PET as a dumb terminal (not both at once). Please specify this option with order.

For those of you who already have a PET, you may order an NCE PET Terminal option separately for $69.

INTEGRAL DATA IMPACT PRINTER

Now you can print on plain paper and make multiple copies on a low-cost printer. The friction-feed IP-125 and the tractor-feed IP-225 80 column, dot-matrix printers are perfect for parallel or RS-232 serial applications at baud rates up to 1200. Graphics, print density and buffer options are available to fit every system's needs. Write for information on options.

IP-125 $799 IP-225 $949

TI PROGRAMMER

SALE!

Hexadecimal, octal, decimal calculator converter

Reg. $59.95 NOW $49.95

CENTRONICS 779 PRINTERS

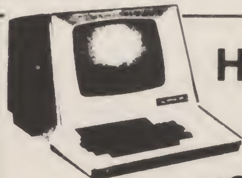
Selectable for 10 or 16.5 char/in. 80 or 132 char/8″ line. Print speeds up to 110 cps. Parallel interface with handshake.

CENTRONICS 779-1 with friction feed

$1035

CENTRONICS 779-2 with tractor feed

$1140



Hazeltine 1400

IN STOCK NOW Only **$699.00**

Now a 5th Generation in Terminals: Immediate Delivery

Hazeltine 1500 full of features	$999
Hazeltine 1510 with buffer logic	$1149
Hazeltine 1520 with printer interface	$1499

call or write for more information

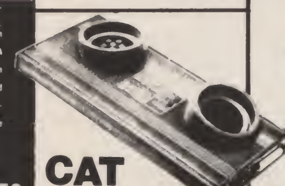
- 28 Double-function keypad including up to 24 "Special" functions
- Easy-to-view 6-digit hex led display
- KIM-1 hardware compatibility
- 6502 based system
- 4K byte ROM resident monitor and operating system
- Single 5 volt power
- 1K bytes of 2114 static RAM on sockets provided for immediate expansion to 4K bytes
- Enhanced software

SYM-1

From Synertek **$269.00**

- Standard interfaces include
  - Audio Cassette Recorder Interface with Remote Control
  - Full Duplex 20mA Teletype Interface
  - System Expansion Bus Interface
  - TV Controller Board Interface
  - CRT Compatible Interface
- 50 I/O Lines in the basic system

NOW IN STOCK — SYM BASIC $159



CAT COUPLER

New 300 baud Originate/Answerback Acoustic Coupler. Looks good, works great and sale priced at **$189.**

KIM-1

The original fully expandable single board computer

SALE Assembled **$169.95**

with power supply **$214.95**

EXPAND YOUR KIM SYSTEM:

KIMSI	
KIM to S-100 Board	
Assembled	$169
Connector Set	15
KIM 4	
Expansion board	89.95
MICRO TECH. POWER SUPPLY Assembled	$34.95

KIM ENCLOSURE

Give your KIM a professional appearance. No alterations required, sturdy Kydex 100 Black **$23.50**

Datel/Selectric Table-top Terminals

- Local, remote or wait status selection
- Computer controllable terminal functions
- Remote interrogation of terminal status
- Interrupt and reverse break
- Interface: RS232C, BCD code

SALE! ~~$395~~ $295 AS IS

NCE/CompuMart, Inc.

1250 North Main Street, Department KB69
P.O. Box 8610 Ann Arbor, Michigan 48107

SUPER SALE

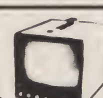
List $279.95

$189.95

S-100 MPA

S-100 MPA gives your PET complete control of the S-100 bus (even DMA). Get an assembled unit at kit price.

SALE



~~$225~~

SANYO MONITOR

VM4209 9″ quality monitor **$169**

10 DAY RETURN PRIVILEGE

(313) 994-3200

Just say charge it! Which card?

• Michigan residents add 4% sales tax • Add 4% shipping and handling for all domestic orders • Foreign orders (except Canada) add 10% additional handling (U.S. currency only) • P.O.'s accepted from D & B rated companies — shipment contingent upon receipt of signed purchase order • Phones open from 9:00 a.m. to 7:00 p.m. EST Monday-Friday, 10:00 a.m. to 5:00 p.m. Saturdays • Open accounts invited — call for credit application • Most items in stock for immediate shipment — call for delivery quotation • Sorry, no C.O.D.'s • All prices subject to change without notice • in the Ann Arbor area? Retail store open 11:00 a.m. to 7:00 p.m. Tuesday-Friday, 10:00 a.m. to 5:00 p.m. Saturdays (Closed Sunday and Monday)

SEND FOR FREE TERMINAL FLYER

for memory, the word is "CHOICE"

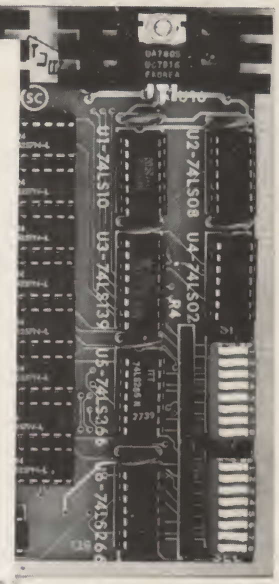
No matter what system you choose — **S-100** based, **Radio Shack-80, H8, Digital Group,** or even the **Intel/National** single board computer system — we have the memory you want. You may choose from a variety of configurations and densities, at a variety of price levels.

We also give you the choice of buying your memory in **unkit** form (sockets, bypass caps pre-soldered in place); **assembled and tested;** or qualified under our **CSC (Certified System Component)** high-reliability program (200 hour burn-in, immediate replacement in event of failure within one year of invoice date, and more).

But there are some areas where we don't give you a choice. You can't choose between 2 and 4 MHz versions of our high density memories, because we only make the 4 MHz type. And you can't choose between low and high power versions — all our memories are designed for very low power operation. An example: our 32K bank select board's guaranteed *maximum* current spec is 3.5A, which is considerably lower than most other *typical* current specs.

We even give you a choice of non-memory products that offer exceptional value and performance, such as our I/O board, motherboards, and active terminator.

How do you get ahold of a **CompuKit**™ product? Well, there's a choice there too. Our products are available from many fine computer stores, or directly from us.



Name	Storage	Buss	Design	Speed	Configuration	Unkit	Assm	CSC
Econoram II	8K X 8	S-100	static	2 MHz	2-4K	**$149**	**$164**	N/A
Econoram IV	16K X 8	S-100	static	4 MHz	1-16K	**$295**	**$329**	**$429**
Econoram VI	12K X 8	H8	static	2 MHz	1-8K, 1-4K	**$200**	**$270**	N/A
Econoram VII	24K X 8	S-100	static	4 MHz	2-4K, 2-8K	**$445**	**$485**	**$605**
Econoram IX	32K X 8	Dig Grp	static	4 MHz	2-4K, 1-8K, 1-16K	**$649**	N/A	N/A
Econoram X	32K X 8	S-100	static	4 MHz	2-8K, 1-16K	**$599**	**$649**	**$789**
Econoram XI	32K X 8	SBC	static	4 MHz	2-8K, 1-16K	N/A	N/A	**$1050**

BANK SELECT MEMORIES (for **Alpha Micro Systems, Marinchip,** etc.)

Name	Storage	Buss	Design	Speed	Configuration	Unkit	Assm	CSC
Econoram XII-16	16K X 8	S-100	static	4 MHz	2 ind. banks*	**$369**	**$419**	**$519**
Econoram XII-24	24K X 8	S-100	static	4 MHz	2 ind. banks*	**$479**	**$539**	**$649**
Econoram XIII	32K X 8	S-100	static	4 MHz	2 ind. banks**	**$629**	**$699**	**$849**

*addressable on 8K boundaries **addressable on 16K boundaries

Econoram is a trade mark of **Godbout Electronics.**

ALSO AVAILABLE: 16K MEMORY EXPANSION CHIP SET $109 (3/$320)

For **Radio Shack-80, Apple, Sorcerer** machines. 250 ns chips for 4 MHz operation, DIP shunts, 1 year limited warranty. With easy-to-follow instructions.

ACTIVE TERMINATOR KIT $34.50

Our much imitated design plugs into any S-100 motherboard to reduce noise, ringing, overshoot, and other buss-related problems.

DUAL CHANNEL/DUAL FUNCTION S-100 I/O BOARD

$189 unkit, $249 assm

This one does things the others can only dream about. Two independently addressable serial ports with full RS232C current loop (20 mA) and TTL signals on both ports, crystal controlled Baud rates to 19.2 KBaud, hardware UARTS, compatible with 2 or 4 MHz systems, low power consumption, and a whole lot more . . . we'll be glad to give you more info, just write.

2102 MEMORY SPECIAL 10/$9.90

That's only **99c** each for *very* low power, static 1K RAMs suitable for use with any 2 MHz system. Price only good on orders of 10 or more.
16 pin lo-profile sockets also available at the special price of **12/$2.00.**

1791 MOS LSI DUAL DENSITY DISC CONTROLLER CHIP $59

Just in. Prime Western Digital parts, with pinout and data.

HEATH H8 BARE BOARD MEMORY SPECIAL — $35!

Don't need the full 12K of our standard H8 memory? We now offer the board, mounting bracket, edge connector, and schematic for only **$35.** Populate it with a few support chips and readily available, low cost 2102s to build your memory up to a full 12K whenever your budget permits.

11 SLOT MOTHERBOARD UNKIT

With 11 edge connectors pre-soldered in place for easy assembly, as well as integral active terminator circuitry. Dimensions: 8.5" X 11" **$90**

18 SLOT MOTHERBOARD UNKIT

Same as above, but 18 slot version with 18 edge connectors. Dimensions: 8.5" X 16.7" **$124**

TERMS: Allow 5% shipping, excess refunded. Cal res add tax. VISA® /Mastercharge® call our 24 hour order desk at **(415) 562-0636.** COD OK with street address for UPS (UPS COD charge applies). Prices good through cover month of magazine. Orders under $15 add $1 handling.

CompuKit™ from **GODBOUT ELECTRONICS**

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G4

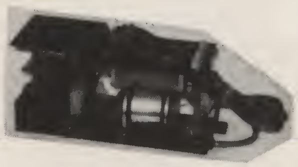
FREE FLYER: We'll be glad to tell you more than the space of this ad allows. Just send your name and address, we'll take care of the rest. If you're in a hurry, enclose 41c in stamps and we'll send it out first class.

Reader Service—see page 179

WALLEN

ELECTRONICS CO. INC. Tel: (617) 588-6440-6441
108 SAWTELL AVE., BROCKTON, MASS. 02402

TEST EQUIPMENT
CONNECTORS-WIRE
ELECT. COMPONENTS



POWER SUPPLIES

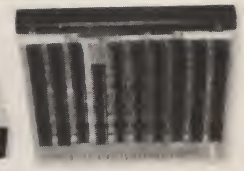
5 volts @ 8 amps + 12 volts, 2 amps + 6 volts @ 75 MA. Ideal for Micro and Mini computers. These units have been removed from equipment and rechecked out and guaranteed. Power supply has a 3-wire line cord and fused. Speci 10-1/2" x 5-1/2" x 4-1/2". Shipping weight 16 lbs.

REGULATED
COMPUTER

37.50
2 FOR 70.00

Wire Wrap BOARDS

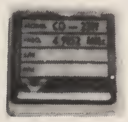
These boards are pre-wired and removed from equipment. Easy to unwrap for setting up your own board. Contains mostly 14-pin IC sockets with individual pin connections. Each board has VCC and ground planes.



Smaller board measures 6½" x 6" and has 40 to 50 sockets. PRICE $11.00 ea. 2/$20.00
Larger board measures 13½" x 6" and has 75 to 100 sockets. PRICE $17.50 ea. 2/$33.00

CRYSTAL OSCILLATORS

Vectron type CO-231T crystal freq. 4.9152, MHZ w/tuning option for accuracy of .0001% 1-1/2" x -1/2". R.F.E.



13.95

ROTRON Whisper Fans

115V, AC, 7 watts, 50-60 Hz. Guaranteed.
4-1/2" x 4-1/2" x 1-1/2". Removed from equipment, checked and guaranteed.

6.95

TEKTRONIX 535A OSCILLOSCOPE

Used equipment. Freq. DC to 15 Mhz. These scopes come w/B, D, K or L plug-in units. Checked out and operating.

$199
W/1 PLUG-IN

(Shipped freight collect)

DUAL TRACE PLUG-INS

Model CA available. Checked out and operating.

$100

TRANSFORMERS ISOLATION/STEP-DOWN TYPE

Primary: 230/115V, 50/60 CPS,
Secondary: VA output 250 V.

13.95 EACH

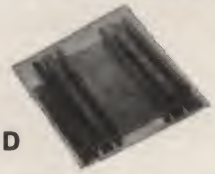
LINE CORDS

LINE CORDS—with ground wire. 6-ft. length, 16/3 type SJ

75¢

SEMI-CONDUCTOR COOLERS (heat sinks)

ALUMINUM BLANKS



1.75 EACH

NOT DRILLED

5" x 4¾" x 1¼"

ANODIZED ALUMINUM FOR TO-3 or TO-66 TRANSISTORS

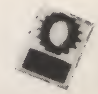
Chassis Mounting

20¢ EA

1 7/8" x 1 1/8"

For TO-5 series tansistors (gear type)

$15



SOLD IN PKG. OF 100s

INCADESCENT READOUT ASSEMBLY

Readouts assembled of the 710 series modules. Character 1" high w/lamps. Type No. 344. By Dialco.

2.75 each

DIABLO SYSTEM Disk Drive

SERIES 40 MODEL 43

100 tracks per inch, total capacity of 50 megabits, w/Model 429 power supply, sector counter, 24 sectors, 1 fixed disc, 1 removable disc, average access time 38 ms, RPM: 2400, dimensions: 10 5/16" high, fits in standard rack, equipped with full extension slides.

$2495

Minimum order $25.00. Items offered subject to prior sale, FOB, Brockton, Mass. Money order or check w/order. Shipping and handling add 5%. Shipments by parcel post or UPS. No CODs. Mass. residents add 5% sales tax.

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A38

THE FIRST TO OFFER PRIME PRODUCTS TO THE HOBBYIST AT FAIR PRICES NOW LOWERS PRICES EVEN FURTHER!

1. Proven Quality Factory tested products only, no re-tests or fallouts. Guaranteed money back. We stand behind our products.

2. Same Day Shipment All prepaid orders with cashiers check, money order or charge card will be shipped same day as received.

STATIC RAM BOARDS

Now, just more than 1/24 per bit!

S-100 32K (uses 2114)

ASSEMBLED		Kit	
450ns.	599.00	450ns.	539.95
250ns.	699.95	250ns.	599.95

Bare Board 49.95
Bare Board w/all parts less mem. 99.95

S-100 16K (uses 2114) KIT (exp. to 32K)

ASSEMBLED			
450ns.	325.00	450ns.	279.00
250ns.	375.00	250ns.	299.00

Bare Board 49.95

LOGOS I 8K
ASSEMBLED

450 ns.	169.95	KIT 450ns.	125.95
250ns.	189.95	250ns.	149.95

Bare PC Board w/Data $21.95
Now over 1 year successful field experience
"Special Offer" Buy (4) 8K 450ns. Kits $117.00

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20 Pin W/W	90	20 Pin S/T	34
22 Pin W/W	93	22 Pin S/T	35
24 Pin W/W	85	24 Pin S/T	41
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AJ A242 Coupler	325.00
I/O to transmit over existing wiring	189.00 A/T
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QTY.				
	1N914	100v	10mA	.05
	1N4005	600v	1A	.08
	1N4007	1000v	1A	.15
	1N4148	75v	10mA	.05
	1N4733	5.1v	1 W Zener	.25
	1N753A	6.2v	500 mW Zener	.25
	1N758A	10v	"	.25
	1N759A	12v	"	.25
	1N5243	13v	"	.25
	1N5244B	14v	"	.25
	1N5245B	15v	"	.25

SOCKETS/BRIDGES

QTY.					
	8-pin	pcb	.20	ww	.35
	14-pin	pcb	.20	ww	.40
	16-pin	pcb	.20	ww	.40
	18-pin	pcb	.25	ww	.95
	20-pin	pcb	.35	ww	.95
	22-pin	pcb	.35	ww	.95
	24-pin	pcb	.35	ww	.95
	28-pin	pcb	.45	ww	1.25
	40-pin	pcb	.50	ww	1.25
	Molex pins	.01	To-3 Sockets		.25
	2 Amp Bridge		100-prv		.95
	25 Amp Bridge		200-prv		1.50

TRANSISTORS, LEDS, etc.

QTY.			
	2N2222	(2N2222 Plastic .10)	.15
	2N2222A		.19
	2N2907A	PNP	.19
	2N3906	PNP (Plastic Unmarked)	.10
	2N3904	NPN (Plastic Unmarked)	.10
	2N3054	NPN	.45
	2N3055	NPN 15A 60v	.60
	T1P125	PNP Darlington	1.95
	LED Green,	Red, Clear, Yellow	.15
	D.L.747	7 seg 5/8" High com-anode	1.95
	MAN72	7 seg com-anode (Red)	1.25
	MAN3610	7 seg com-anode (Orange)	1.25
	MAN82A	7 seg com-anode (Yellow)	1.25
	MAN74	7 seg com-cathode (Red)	1.50
	FND359	7 seg com-cathode (Red)	1.25

9000 SERIES

QTY.			QTY.		
	9301	.85		9322	.65
	9309	.35		9601	.20
	9316	1.10		9602	.45

MICRO'S, RAMS, CPU'S, E-PROMS

QTY.			QTY.		
	8T13	1.50		2107B-4	4.95
	8T23	1.50		2114	9.50
	8T24	2.00		2513	6.25
	8T97	1.00		2708	10.50
	74S188	3.00		2716 D.S.	34.00
	1488	1.25		2716 (5v)	59.00
	1489	1.25		2758 (5v)	23.95
	1702A	4.50		3242	10.50
	AM 9050	4.00		4116	11.50
				6800	13.95
	MM 5314	3.00		6850	7.95
	MM 5316	3.50		8080	7.50
	MM 5387	3.50		8212	2.75
	MM 5369	2.95		8214	4.95
	TR 1602B	3.95		8216	3.50
	UPD 414	4.95		8224	3.25
	Z 80 A	22.50		8228	6.00
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	2102	1.45		8255	8.50
	2102L	1.75		TMS 4044	9.95

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QTY.		
	4000	.15
	4001	.15
	4002	.20
	4004	3.95
	4006	.95
	4007	.20
	4008	.75
	4009	.35
	4010	.35
	4011	.20
	4012	.20
	4013	.40
	4014	.75
	4015	.75
	4016	.35
	4017	.75
	4018	.75
	4019	.35
	4020	.85
	4021	.75
	4022	.75
	4023	.20
	4024	.75
	4025	.20
	4026	1.95
	4027	.35
	4028	.75
	4029	1.15
	4030	.30
	4033	1.50
	4034	2.45
	4035	.75
	4037	1.80
	4040	.75
	4041	.69
	4042	.65
	4043	.50
	4044	.65
	4046	1.25
	4048	.95
	4049	.45
	4050	.45
	4052	.75
	4053	.75
	4066	.55
	4069/74C04	.35
	4071	.25
	4081	.30
	4082	.30
	4507	.95
	4511	.95
	4512	1.10
	4515	2.95
	4519	.85
	4522	1.10
	4526	.95
	4528	1.10
	4529	.95
	MC14409	14.50
	MC14419	4.85
	74C151	1.50

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QTY.			QTY.			QTY.		
	MCT2	.95		LM323K	5.95		LM380 (8-14 Pin)	1.19
	8038	3.95		LM324	1.25		LM709 (8-14 Pin)	.35
	LM201	.75		LM339	.75		LM711	.45
	LM301	.45		7805 (340T5)	.95		LM723	.40
	LM308	.65		LM340T12	.95		LM725	2.50
	LM309H	.65		LM340T15	.95		LM739	1.50
	LM309K (340K-5)	1.50		LM340T18	.95		LM741 (8-14)	.35
	LM310	.85		LM340T24	.95		LM747	1.10
	LM311D	.75		LM340K12	1.25		LM1307	1.25
	LM318	1.75		LM340K15	1.25		LM1458	.65
	LM320H6	.79		LM340K18	1.25		LM3900	.50
	LM320H15	.79		LM340K24	1.25		LM75451	.65
	LM320H24	.79		LM373	2.95		NE555	.45
	7905 (LM320K5)	1.65		LM377	3.95		NE556	.85
	LM320K12	1.65		78L05	.75		NE565	.95
	LM320K24	1.65		78L12	.75		NE566	1.25
	LM320T5	1.65		78L15	.75		NE567	.95
	LM320T12	1.65		78M05	.75			
	LM320T15	1.65						

– TTL –

QTY.			QTY.			QTY.			QTY.		
	7400	.10		7482	.75		74221	1.00		74LS02	.30
	7401	.15		7483	.75		74367	.95		74LS04	.30
	7402	.15		7485	.55		75108A	.35		74LS05	.35
	7403	.15		7486	.25		75491	.50		74LS08	.35
	7404	.10		7489	1.05		75492	.50		74LS09	.35
	7405	.25		7490	.45		74H00	.15		74LS10	.35
	7406	.25		7491	.70		74H01	.20		74LS11	.35
	7407	.55		7492	.45		74H04	.20		74LS20	.30
	7408	.15		7493	.35		74H05	.20		74LS21	.35
	7409	.15		7494	.75		74H08	.35		74LS22	.35
	7410	.15		7495	.60		74H10	.35		74LS32	.35
	7411	.25		7496	.80		74H11	.25		74LS37	.35
	7412	.25		74100	1.15		74H15	.45		74LS38	.45
	7413	.25		74107	.25		74H20	.25		74LS40	.40
	7414	.75		74121	.35		74H21	.25		74LS42	.75
	7416	.25		74122	.55		74H22	.40		74LS51	.45
	7417	.40		74123	.35		74H30	.20		74LS74	.45
	7420	.15		74125	.45		74H40	.25		74LS76	.50
	7426	.25		74126	.35		74H50	.25		74LS86	.45
	7427	.25		74132	.75		74H51	.25		74LS90	.65
	7430	.15		74141	.90		74H52	.15		74LS93	.65
	7432	.20		74150	.85		74H53	.25		74LS107	.50
	7437	.20		74151	.65		74H55	.20		74LS123	1.20
	7438	.20		74153	.75		74H72	.35		74LS151	.85
	7440	.20		74154	.95		74H74	.35		74LS153	.85
	7441	1.15		74156	.70		74H101	.75		74LS157	.85
	7442	.45		74157	.65		74H103	.55		74LS160	.95
	7443	.45		74161	.55		74H106	.95		74LS164	1.20
	7444	.45		74163	.85		74L00	.25		74LS193	1.05
	7445	.65		74164	.60		74L02	.20		74LS195	.95
	7446	.70		74165	1.10		74L03	.25		74LS244	1.70
	7447	.70		74166	1.25		74L04	.30		74LS367	.95
	7448	.50		74175	.80		74L10	.20		74LS368	.95
	7450	.25		74176	.85		74L20	.35		74S00	.35
	7451	.25		74180	.55		74L30	.45		74S02	.35
	7453	.20		74181	2.25		74L47	1.95		74S03	.25
	7454	.25		74182	.75		74L51	.45		74S04	.25
	7460	.40		74190	1.25		74L55	.65		74S05	.35
	7470	.45		74191	1.25		74L72	.45		74S08	.35
	7472	.40		74192	.75		74L73	.40		74S10	.35
	7473	.25		74193	.85		74L74	.45		74S11	.35
	7474	.30		74194	.95		74L75	.85		74S20	.25
	7475	.35		74195	.95		74L93	.55		74S40	.20
	7476	.40		74196	.95		74L123	.85		74S50	.20
	7480	.55		74197	.95		74LS00	.30		74S51	.25
	7481	.75		74198	1.45		74LS01	.30		74S64	.15
										74S74	.35
										74S112	.60
										74S114	.65
										74S133	.40
										74S140	.55
										74S151	.30
										74S153	.35
										74S157	.75
										74S158	.30
										74S194	1.05
										74S257 (8123)	1.05
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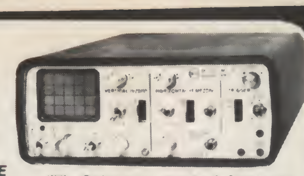

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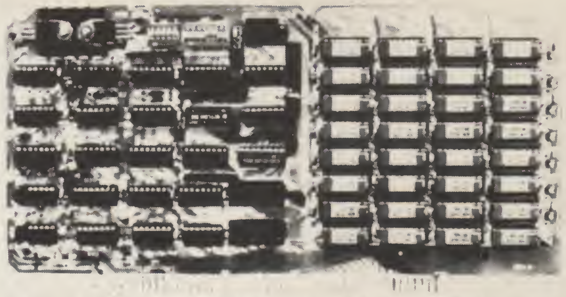

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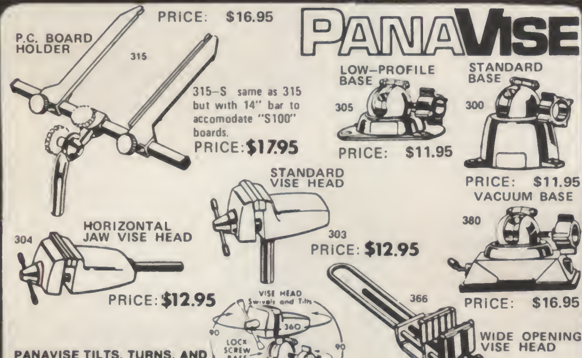

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		SN7472N	.29		
SN7400N	.16	SN7473N	.35	SN74160N	.89
SN7401N	.18	SN7474N	.35	SN74161N	.89
SN7402N	.18	SN7475N	.49	SN74162N	1.95
SN7403N	.18	SN7476N	.35	SN74163N	.89
SN7404N	.18	SN7479N	5.00	SN74164N	.89
SN7405N	.20	SN7480N	.50	SN74165N	.89
SN7406N	.29	SN7482N	.99	SN74166N	1.25
SN7407N	.29	SN7483N	.59	SN74167N	1.95
SN7408N	.20	SN7485N	.79	SN74170N	1.59
SN7409N	.20	SN7486N	.35	SN74172N	6.00
SN7410N	.18	SN7489N	1.75	SN74173N	1.25
SN7411N	.25	SN7490N	.45	SN74174N	.89
SN7412N	.25	SN7491N	.59	SN74175N	.79
SN7413N	.40	SN7492N	.43	SN74176N	.79
SN7414N	.70	SN7493N	.43	SN74177N	.79
SN7416N	.25	SN7494N	.65	SN74179N	1.95
SN7417N	.25	SN7495N	.65	SN74180N	.79
SN7420N	.20	SN7496N	.65	SN74181N	1.95
SN7421N	.29	SN7497N	3.00	SN74182N	.79
SN7422N	.39	SN74100N	.89	SN74184N	1.95
SN7423N	.29	SN74107N	.35	SN74185N	1.95
SN7425N	.29	SN74109N	.59	SN74186N	9.95
SN7426N	.29	SN74116N	1.95	SN74188N	3.95
SN7427N	.25	SN74121N	.35	SN74190N	1.25
SN7429N	.39	SN74122N	.39	SN74191N	1.25
SN7430N	.20	SN74123N	.49	SN74192N	.79
SN7432N	.25	SN74125N	.49	SN74193N	.79
SN7437N	.25	SN74126N	.49	SN74194N	.89
SN7438N	.25	SN74132N	.75	SN74195N	.69
SN7439N	.25	SN74136N	.75	SN74196N	.89
SN7440N	.20	SN74141N	.79	SN74197N	.89
SN7441N	.89	SN74142N	2.95	SN74198N	1.49
SN7442N	.49	SN74143N	2.95	SN74199N	1.49
SN7443N	.75	SN74144N	2.95	SN74S200	4.95
SN7444N	.75	SN74145N	.75	SN74251N	1.79
SN7445N	.75	SN74147N	1.95	SN74279N	.79
SN7446N	.69	SN74148N	1.29	SN74283N	2.25
SN7447N	.59	SN74150N	.89	SN74284N	3.95
SN7448N	.79	SN74151N	.59	SN74285N	3.95
SN7450N	.20	SN74152N	.59	SN74365N	.69
SN7451N	.20	SN74153N	.59	SN74366N	.69
SN7453N	.20	SN74154N	.99	SN74367N	.69
SN7454N	.20	SN74155N	.79	SN74368N	.69
SN7459A	.25	SN74156N	.79	SN74390N	1.95
SN7460N	.20	SN74157N	.65	SN74393N	1.95

C/MOS

CD4000	.23			CD4070	.55
CD4001	.23	CD4028	.89	CD4071	.23
CD4002	.23	CD4029	1.19	CD4072	.49
CD4006	1.19	CD4030	.49	CD4076	1.39
CD4007	.25	CD4035	.99	CD4081	.23
CD4009	.49	CD4040	1.19	CD4082	.23
CD4010	.49	CD4041	1.25	CD4093	.99
CD4011	.23	CD4042	.99	CD4098	2.49
CD4012	.25	CD4043	.89	MC14409	14.95
CD4013	.39	CD4044	.89	MC14410	14.95
CD4014	1.39	CD4046	1.79	MC14411	14.95
CD4015	1.19	CD4047	2.50	MC14419	4.95
CD4016	.49	CD4048	1.35	MC14433	19.95
CD4017	1.19	CD4049	.49	MC14506	.75
CD4018	.99	CD4050	.49	MC14507	.99
CD4019	.49	CD4051	1.19	MC14562	14.50
CD4020	1.19	CD4053	1.19	MC14583	3.50
CD4021	1.39	CD4056	2.95	CD4508	3.95
CD4022	1.19	CD4059	9.95	CD4510	1.39
CD4023	.23	CD4060	1.49	CD4511	1.29
CD4024	.79	CD4066	.79	CD4515	2.95
CD4025	.23	CD4068	.39	CD4518	1.29
CD4026	2.25	CD4069	.45	CD4520	1.29
CD4027	.69			CD4566	2.25

74C00

74C00	.39			74C163	2.49
74C02	.39			74C164	2.49
74C04	.39	74C85	2.49	74C173	2.60
74C08	.49	74C90	1.95	74C192	2.49
74C10	.39	74C93	1.95	74C193	2.49
74C14	1.95	74C95	1.95	74C195	2.49
74C20	.39	74C107	1.25	74C922	5.95
74C30	.39	74C151	2.90	74C923	6.25
74C42	1.95	74C154	3.00	74C925	8.95
74C48	2.49	74C157	2.15	74C926	8.95
74C73	.89	74C160	2.49	80C95	1.50
74C74	.89	74C161	2.49	80C97	1.50

LINEAR

78MG	1.75			LM710N	.79
LM106H	.99	LM340K-18	1.35	LM711N	.39
LM300H	.80	LM340K-24	1.35	LM723N/H	.55
LM301CN/H	.35	LM340T-5	1.25	LM733N	1.00
LM302H	.75	LM340T-6	1.25	LM739N	1.19
LM304H	1.00	LM340T-8	1.25	LM741CN/H	.35
LM305H	.60	LM340T-12	1.25	LM741-14N	.39
LM307CN/H	.35	LM340T-15	1.25	LM747N/H	.79
LM308CN/H	1.00	LM340T-18	1.25	LM748N/H	.39
LM309H	1.10	LM340T-24	1.25	LM1310N	2.95
LM309K	1.25	LM358N	1.00	LM1458CN/H	.59
LM310CN	1.15	LM370N	1.95	LM1488N	1.39
LM311N/H	.90	LM373N	3.25	LM1489N	1.39
LM312H	1.95	LM377N	4.00	LM1496N	.95
LM317K	6.50	LM380N	1.25	LM1556V	1.75
LM318CN/H	1.50	LM380CN	.99	MC1741SCP	3.00
LM319N	1.30	LM381N	1.79	LM2111N	1.95
LM320K-5	1.35	LM382N	1.79	LM2901N	2.95
LM320K-5.2	1.35	NE501N	8.00	LM3053N	1.50
LM320K-12	1.35	NE510A	6.00	LM3065N	1.49
LM320K-15	1.35	NE529A	4.95	LM3900N(3401)	.49
LM320K-18	1.35	NE531H/V	3.95	LM3905N	.89
LM320K-24	1.35	NE536T	6.00	LM3909N	1.25
LM320T-5	1.25	NE540L	6.00	MC5558V	.59
LM320T-5.2	1.25	NE544N	4.95	80388	4.95
LM320T-8	1.25	NE550N	1.30	LM75450N	.49
LM320T-12	1.25	NE555V	.39	75451CN	.39
LM320T-15	1.25	NE556N	.99	75452CN	.39
LM320T-18	1.25	NE560B	5.00	75453CN	.39
LM320T-24	1.25	NE561B	5.00	75454CN	.39
LM323K-5	5.95	NE562B	5.00	75491CN	.79
LM324N	1.80	NE565N/H	1.25	75492CN	.89
LM339N	.99	NE566CN	1.75	75493N	.89
LM340K-5	1.35	NE567V/H	.99	75494CN	.89
LM340K-6	1.35	NE570N	4.95	RC4136	1.25
LM340K-8	1.35	LM703CN/H	.69	RC4151	2.85
LM340K-12	1.35	LM709N/H	.29	RC4194	5.95
LM340K-15	1.35			RC4195	4.49

74LS00TTL

74LS00	.29			74LS138	.89
74LS01	.29	74LS47	.89	74LS139	.89
74LS02	.29	74LS51	.29	74LS151	.89
74LS03	.29	74LS54	.29	74LS155	.89
74LS04	.35	74LS55	.29	74LS157	.89
74LS05	.35	74LS73	.45	74LS160	1.15
74LS08	.29	74LS74	.45	74LS161	1.15
74LS09	.35	74LS75	.59	74LS162	1.15
74LS10	.29	74LS76	.45	74LS163	1.15
74LS11	.75	74LS78	.49	74LS164	1.25
74LS13	.59	74LS83	.89	74LS175	.99
74LS14	1.25	74LS85	1.25	74LS181	2.49
74LS15	.29	74LS86	.45	74LS190	1.15
74LS20	.29	74LS90	.59	74LS191	1.15
74LS21	.35	74LS92	.75	74LS192	1.15
74LS22	.35	74LS93	.75	74LS193	1.15
74LS26	.35	74LS95	.99	74LS194	1.15
74LS27	.35	74LS96	1.15	74LS195	1.15
74LS28	.35	74LS107	.45	74LS253	.99
74LS30	.29	74LS109	.45	74LS257	.89
74LS32	.35	74LS112	.45	74LS258	1.75
74LS37	.45	74LS123	1.25	74LS260	.69
74LS40	.35	74LS125	.89	74LS279	.75
74LS42	.89	74LS132	.99	74LS367	.75
		74LS136	.49	74LS368	.75
				74LS670	2.49

EXCITING NEW KITS!

Regulated Power Supply
5 to 15 VDC

NEW

- *Full 1.5 amp at 5-10V output – Up to .5 amp at 15V output
- *Heavy duty transformer
- *3 terminal I.C. Volt. Reg.
- *Heat sink provided for cooling efficiency
- *PC Board construction
- *120 VAC input
- *Size: 3½"W x 5"L x 2"H

JE210 5 to 15 VDC **$19.95**

Digital Thermometer Kit

NEW

- Dual sensors—switching control for in-door/outdoor or dual monitoring
- Continuous LED .8" ht. display
- Range: -40°F to 199°F / -40°C to 100°C
- Accuracy: ±1° nominal
- Set for Fahrenheit or Celsius reading
- Sim. walnut case - AC wall adapter incl.
- Size: 3-1/4"H x 6-5/8"W x 1-3/8"D

JE300 . . . .$39.95

DISCRETE LEDS

.200" dia.			.125" dia.		
XC556R	red	5/$1	XC209R	red	5/$1
XC556G	green	4/$1	XC209G	green	4/$1
XC556Y	yellow	4/$1	XC209Y	yellow	4/$1
XC556C	clear	4/$1			
.200" dia.			.185" dia.		
XC22R	red	5/$1	XC526R	red	5/$1
XC22G	green	4/$1	XC526G	green	4/$1
XC22Y	yellow	4/$1	XC526Y	yellow	4/$1
.170" dia.			XC526C	clear	4/$1
MV10B	red	4/$1	.190" dia.		
.085" dia.			XC111R	red	5/$1
MV50	red	6/$1	XC111G	green	4/$1
			XC111Y	yellow	4/$1
			XC111C	clear	4/$1

INFRA-RED LED
1/4"x1/4"x1/16" flat
5/$1

TIMEX T1001
LIQUID CRYSTAL DISPLAY
FIELD EFFECT

4 DIGIT – .5" CHARACTERS
THREE ENUNCIATORS
2.00" X 1.20" PACKAGE
INCLUDES CONNECTOR

T1001-Transmissive $7.95
T1001A-Reflective 8.25

DISPLAY LEDS

TYPE	POLARITY	HT	PRICE	TYPE	POLARITY	HT	PRICE
MAN 1	Common Anode-red	.270	2.95	MAN 6730	Common Anode-red ± 1	.560	.99
MAN 2	5 x 7 Dot Matrix-red	.300	4.95	MAN 6740	Common Cathode-red-D.D	.560	.99
MAN 3	Common Cathode-red	.125	.25	MAN 6750	Common Cathode-red ± 1	.560	.99
MAN 4	Common Cathode-red	.187	1.95	MAN 6760	Common Anode-red	.560	.99
MAN 7G	Common Anode-green	.300	1.25	MAN 6780	Common Cathode-red	.560	.99
MAN 7Y	Common Anode-yellow	.300	.99	DL701	Common Anode-red ± 1	.300	.99
MAN 72	Common Anode-red	.300	.99	DL704	Common Cathode-red	.300	.99
MAN 74	Common Cathode-red	.300	1.25	DL707	Common Anode-red	.300	.99
MAN 82	Common Anode-yellow	.300	.99	DL728	Common Cathode-red	.500	1.49
MAN 84	Common Cathode-yellow	.300	.99	DL741	Common Anode-red	.600	1.25
MAN 3620	Common Anode-orange	.300	.99	DL746	Common Anode-red ± 1	.630	1.49
MAN 3630	Common Anode-orange ± 1	.300	.99	DL747	Common Anode-red	.600	1.49
MAN 3640	Common Cathode-orange	.300	.99	DL749	Common Cathode-red ± 1	.630	1.49
MAN 4610	Common Anode-orange	.300	.99	DL750	Common Cathode-red	.600	1.49
MAN 4640	Common Cathode-orange	.400	.99	DL338	Common Cathode-red	.110	.35
MAN 4710	Common Anode-red	.400	.99	FND70	Common Cathode	.250	.69
MAN 4730	Common Anode-red ± 1	.400	.99	FND358	Common Cathode ± 1	.357	.99
MAN 4740	Common Cathode-red	.400	.99	FND359	Common Cathode	.357	.75
MAN 4810	Common Anode-yellow	.400	.99	FND503	Common Cathode(FND500)	.500	.99
MAN 4840	Common Cathode-yellow	.400	.99	FND507	Common Anode (FND510)	.500	.99
MAN 6610	Common Anode-orange-D.D.	.560	.99	5082-7730	Common Anode-red	.300	1.30
MAN 6630	Common Anode-orange ± 1	.560	.99	HDSP-3400	Common Anode-red	.800	2.10
MAN 6640	Common Cathode-orange-D.D.	.560	.99	HDSP-3403	Common Cathode red	.800	2.10
MAN 6650	Common Cathode-orange ± 1	.560	.99	5082-7300	4 x 7 sgl. Digit-RHDP	.600	19.95
MAN 6660	Common Anode-orange	.560	.99	5082-7302	4 x 7 Sgl. Digit-LHDP	.600	19.95
MAN 6680	Common Cathode-orange	.560	.99	5082-7304	Overrange character (±1)	.600	15.00
MAN 6710	Common Anode-red-D.D.	.560	.99	5082-7340	4 x 7 Sgl. Digit-Hexadecimal	.600	22.50

RCA LINEAR

CA3013T	2.15	CA3082N	2.00
CA2023T	2.56	CA3083N	1.60
CA3035T	2.48	CA3086N	.85
CA3039T	1.35	CA3089N	3.75
CA3046N	1.30	CA3130T	1.39
CA3059N	3.25	CA3140T	1.25
CA3060N	3.25	CA3160T	1.25
CA3080T	.85	CA3401N	.49
CA3081N	2.00	CA3600N	3.50

CALCULATOR CHIPS/DRIVERS

MM5725	$2.95
MM5738	2.95
DM8864	2.00
DM8865	1.00
DM8887	.75
DM8889	.75
9374 7 seg C.A. LED driver	

CLOCK CHIPS

MM5309	$4.95
MM5311	4.95
MM5312	4.95
MM5314	4.95
MM5316	6.95
MM5318	9.95
MM5369	2.95
MM5387/1998A	4.95
MM5841	9.95

MOTOROLA

MC1408L7	$4.95
MC1408L8	5.75
MC1439L	2.95
MC3022P	2.95
MC3061P	3.50
MC4016(74416)	7.50
MC4024P	3.95
MC4040P	6.95
MC4044P	4.50

IC SOLDERTAIL — LOW PROFILE (TIN) SOCKETS

	1-24	25-49	50-100		1-24	25-49	50-100
8 pin LP	$17	.16	.15	22 pin LP	$ .37	.36	.35
14 pin LP	.20	.19	.18	24 pin LP	.38	.37	.36
16 pin LP	.22	.21	.20	28 pin LP	.45	.44	.43
18 pin LP	.29	.28	.27	36 pin LP	.60	.59	.58
20 pin LP	.34	.32	.30	40 pin LP	.63	.62	.61

SOLDERTAIL STANDARD (TIN)

	1-24	25-49	50-100		1-24	25-49	50-100
14 pin ST	$.27	.25	.24	28 pin ST	$ .99	.90	.81
16 pin ST	.30	.27	.25	36 pin ST	1.39	1.26	1.15
18 pin ST	.35	.32	.30	40 pin ST	1.59	1.45	1.30
24 pin ST	.49	.45	.42				

SOLDERTAIL STANDARD (GOLD)

	1-24	25-49	50-100		1-24	25-49	50-100
8 pin SG	$.30	.27	.24	24 pin SG	$ .70	.63	.57
14 pin SG	.35	.32	.29	28 pin SG	1.10	1.00	.90
16 pin SG	.38	.35	.32	36 pin SG	1.65	1.40	1.26
18 pin SG	.52	.47	.43	40 pin SG	1.75	1.59	1.45

WIRE WRAP SOCKETS (GOLD) LEVEL #3

	1-24	25-49	50-100		1-24	25-49	50-100
8 pin WW	$.39	.38	.31	22 pin WW	$ .95	.85	.75
10 pin WW	.45	.41	.37	24 pin WW	1.05	.95	.85
14 pin WW	.39	.38	.37	28 pin WW	1.40	1.25	1.10
16 pin WW	.43	.42	.41	36 pin WW	1.59	1.45	1.30
18 pin WW	.75	.68	.62	40 pin WW	1.75	1.55	1.40

1/4 WATT RESISTOR ASSORTMENTS – 5%

ASST. 1	5 ea	10 OHM / 27 OHM	12 OHM / 33 OHM	15 OHM / 39 OHM	18 OHM / 47 OHM	22 OHM / 56 OHM	50 PCS	$1.75
ASST. 2	5 ea	68 OHM / 180 OHM	82 OHM / 220 OHM	100 OHM / 270 OHM	120 OHM / 330 OHM	150 OHM / 390 OHM	50 PCS	1.75
ASST. 3	5 ea	470 OHM / 1.2K	560 OHM / 1.5K	680 OHM / 1.8K	820 OHM / 2.2K	1K / 2.7K	50 PCS	1.75
ASST. 4	5 ea	3.3K / 8.2K	3.9K / 10K	4.7K / 12K	5.6K / 15K	6.8K / 18K	50 PCS	1.75
ASST. 5	5 ea	22K / 56K	27K / 68K	33K / 82K	39K / 100K	47K / 120K	50 PCS	1.75
ASST. 6	5 ea	150K / 390K	180K / 470K	220K / 560K	270K / 680K	330K / 820K	50 PCS	1.75
ASST. 7	5 ea	1M / 2.7M	1.2M / 3.3M	1.5M / 3.9M	1.8M / 4.7M	2.2M / 5.6M	50 PCS	1.75

ASST. 8R Includes Resistor Assortments 1-7 (350 PCS.) **$9.95 ea.**

TELEPHONE/KEYBOARD CHIPS

AY-5-9100	Push Button Telephone Dialler	$14.95
AY-5-9200	Repertory Dialler	14.95
AY-5-9500	CMOS Clock Generator	4.95
AY-5-2376	Keyboard Encoder (88 keys)	14.95
HD0165	Keyboard Encoder (16 keys)	7.95
74C922	Keyboard Encoder (16 keys)	5.95

ICM CHIPS

ICM7045	CMOS Precision Timer	24.95
ICM7205	CMOS LED Stopwatch/Timer	19.95
ICM7207	Oscillator Controller	7.50
ICM7208	Seven Decade Counter	19.95
ICM7209	Clock Generator	6.95

NMOS READ ONLY MEMORIES

MCM6571	128 X 9 X 7 ASCII Shifted with Greek	13.50
MCM6574	128 X 9 X 7 Math Symbol & Pictures	13.50
MCM6575	128 X 9 X 7 Alphanumeric Control Character Generator	13.50

MISCELLANEOUS

TL074CN	Quad Low Noise bi-fet Op Amp	2.49
TL494CN	Switching Regulator	4.49
TL496CP	Single Switching Regulator	1.75
11C90	Divide 10/11 Prescaler	19.95
95H90	Hi-Speed Divide 10/11 Prescaler	11.95
4N33	Photo-Darlington Opto-Isolator	3.95
MK50240	Top Octave Freq. Generator	17.50
DS0026CH	5Mhz 2-phase MOS clock driver	3.75
TIL308	.27" red num. display w/integ. logic chip	10.50
MM5320	TV Camera Sync. Generator	14.95
MM5330	4½ Digit DPM Logic Block (Special)	3.95
LD110/111	3½ Digit A/D Converter Set	25.00/set

LITRONIX ISO-LIT 1
Photo Transistor Opto-Isolator
(Same as MCT 2 or 4N25)
2/99¢

SN 76477
SOUND GENERATOR
Generates Complex Sounds
Low Power - Programmable
3.95 each

TV GAME CHIP AND CRYSTAL
AY-3-8500-1 and 2.01 MHZ Crystal (Chip & Crystal includes score display, 6 games and select angles, etc. **7.95/set**

EXAR

XR205	$8.40			XR2242CP	1.50
XR210	4.40			XR2264	4.25
XR215	4.40			XR2556	3.20
XR320	1.55	JE2206KA	14.95	XR2567	2.99
XR-L555	1.50	JE2206KB	19.95	XR3403	1.25
XR555	.39	XR1800	3.20	XR4136	1.25
XR556	.99	XR2206	4.40	XR4151	2.85
XR567CP	.99	XR2207	3.85	XR4194	4.95
XR567CT	1.25	XR2208	5.20	XR4202	3.60
XR1310P	1.30	XR2209	1.75	XR4212	2.05
XR1468CN	3.85	XR2211	5.25	XR4558	.75
XR1488	1.39	XR2212	4.35	XR4739	1.15
XR1489	1.39	XR2240	3.45	XR4741	1.47

DIODES

TYPE	VOLTS	W	PRICE	TYPE	VOLTS	W	PRICE
				1N4002	100 PIV	1 AMP	12/1.00
1N746	3.3	400m	4/1.00	1N4003	200 PIV	1 AMP	12/1.00
1N751	5.1	400m	4/1.00	1N4004	400 PIV	1 AMP	12/1.00
1N752	5.6	400m	4/1.00	1N4005	600 PIV	1 AMP	10/1.00
1N753	6.2	400m	4/1.00	1N4006	800 PIV	1 AMP	10/1.00
1N754	6.8	400m	4/1.00	1N4007	1000 PIV	1 AMP	10/1.00
1N757	9.0	400m	4/1.00	1N3600	50	200m	6/1.00
1N759	12.0	400m	4/1.00	1N4148	75	10m	15/1.00
1N959	8.2	400m	4/1.00	1N4154	35	10m	12/1.00
1N965	15	400m	4/1.00	1N4305	75	25m	15/1.00
1N5232	5.6	500m	28	1N4734	5.6	1w	28
1N5234	6.2	500m	28	1N4735	6.2	1w	28
1N5235	6.8	500m	28	1N4736	6.8	1w	28
1N5236	7.5	500m	28	1N4738	8.2	1w	28
1N5242	12	500m	28	1N4742	12	1w	28
1N5245	15	500m	28	1N4744	15	1w	28
1N456	25	40m	6/1.00	1N1183	50 PIV	35 AMP	1.60
1N458	150	7m	6/1.00	1N1184	100 PIV	35 AMP	1.70
1N485A	180	10m	5/1.00	1N1185	150 PIV	35 AMP	1.70
1N4001	50 PIV	1 AMP	12/1.00	1N1186	200 PIV	35 AMP	1.80
				1N1188	400 PIV	35 AMP	3.00

SCR AND FW BRIDGE RECTIFIERS

C36D	15A @ 400V	SCR(2N1849)	$1.95
C38M	35A @ 600V	SCR	1.95
2N2328	1.6A @ 300V	SCR	.50
MDA 980-1	12A @ 50V	FW BRIDGE REC.	1.95
MDA 980-3	12A @ 200V	FW BRIDGE REC.	1.95

TRANSISTORS

C106B1	.50			2N3904	4/1.00
MPSA05	.30	2N3055	.89	2N3905	4/1.00
MPSA06	5/1.00	MJE3055	1.00	2N3906	4/1.00
TIS97	6/1.00	2N3392	5/1.00	2N4013	3/1.00
TIS98	6/1.00	2N3398	5/1.00	2N4123	6/1.00
40409	1.75	PN3567	3/1.00	PN4249	4/1.00
40410	1.75	PN3568	4/1.00	PN4250	4/1.00
40673	1.75	PN3569	4/1.00	2N4400	4/1.00
2N918	4/1.00	MPS3638A	5/1.00	2N4401	4/1.00
2N2219A	2/1.00	MPS3702	5/1.00	2N4402	4/1.00
2N2221A	4/1.00	2N3704	5/1.00	2N4403	4/1.00
2N2222A	5/1.00	MPS3704	5/1.00	2N4409	5/1.00
PN2222 Plastic	7/1.00	2N3705	5/1.00	2N5086	4/1.00
2N2369	5/1.00	MPS3705	5/1.00	2N5087	4/1.00
2N2369A	4/1.00	2N3706	5/1.00	2N5088	4/1.00
MPS2369	5/1.00	MPS3706	5/1.00	2N5089	4/1.00
2N2484	4/1.00	2N3707	5/1.00	2N5129	5/1.00
2N2906	4/1.00	2N3711	5/1.00	PN5134	5/1.00
2N2907	5/1.00	2N3724A	.65	PN5138	5/1.00
PN2907 Plastic	7/1.00	2N3725A	1.00	2N5139	5/1.00
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MJE2955	1.25	2N3823	1.00	2N5449	3/1.00
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100 pf	.05	.04	.03	.022μF	.06	.05	.04
220 pf	.05	.04	.03	.047μF	.06	.05	.04
470 pf	.05	.04	.035	1μF	.12	.09	.075

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.0022	.12	.10	.07	.047mf	.21	.17	.13
.0047mf	.12	.10	.07	.1mf	.27	.23	.17
.01mf	.12	.10	.07	.22mf	.33	.27	.22

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.15/35V	.28	.23	.17	2.2/25V	.31	.27	.22
.22/35V	.28	.23	.17	3.3/25V	.31	.27	.22
.33/35V	.28	.23	.17	4.7/25V	.32	.28	.23
.47/35V	.28	.23	.17	6.8/25V	.36	.31	.25
.68/35V	.28	.23	.17	10/25V	.40	.35	.29
1.0/35V	.28	.23	.17	15/25V	.63	.50	.40

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1.0/50V	.16	.14	.11	.47/50V	.16	.14	.11
3.3/50V	.14	.12	.09	1.0/16V	.15	.13	.10
4.7/25V	.15	.13	.10	1.0/25V	.16	.14	.11
10/25V	.15	.13	.10	1.0/50V	.16	.14	.11
10/50V	.16	.14	.12	4.7/16V	.15	.13	.10
22/25V	.17	.15	.12	4.7/25V	.15	.13	.10
22/50V	.24	.20	.18	4.7/50V	.16	.14	.11
47/25V	.19	.17	.15	10/16V	.14	.12	.09
47/50V	.25	.21	.19	10/25V	.15	.13	.10
100/25V	.24	.20	.18	10/50V	.16	.14	.12
100/50V	.35	.30	.28	47/50V	.24	.21	.19
220/25V	.32	.28	.25	100/16V	.19	.15	.14
220/50V	.45	.41	.38	100/25V	.24	.20	.18
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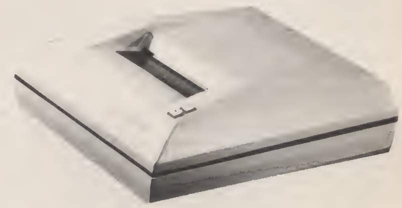

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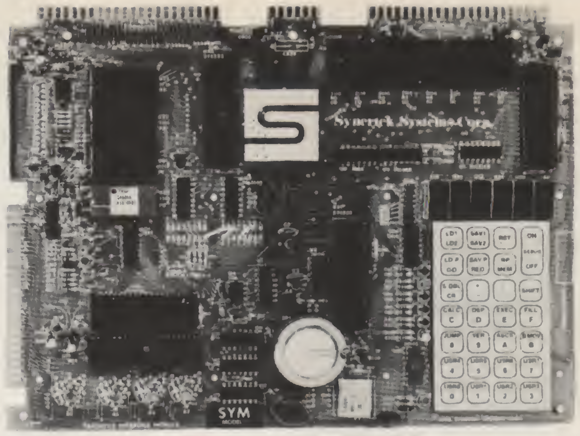

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- SEPARATE POWER SUPPLY connector for easy disconnect of the d-c power
- AUDIBLE RESPONSE KEYPAD

Synertek has enhanced KIM-1* software as well as the hardware. The software has simplified the user interface. The basic SYM-1 system is programmed in machine language. Monitor status is easily accessible, and the monitor gives the keypad user the same full functional capability of the TTY user. The SYM-1 has everything the KIM-1* has to offer, plus so much more that we cannot begin to tell you here. So, if you want to know more, the SYM-1 User Manual is available, separately.

SYM-1 Complete w/manuals	**$269.00**
SYM-1 User Manual Only	**7.00**
SYM-1 Expansion Kit	**75.00**

Expansion includes 3K of 2114 RAM chips and 1-6522 I/O chip.

SYM-1 Manuals: The well organized documentation package is complete and easy-to-understand.

SYM-1 CAN GROW AS YOU GROW. It's the system to BUILD-ON. Expansion features that are available:

BAS-1 8K Basic ROM (Microsoft Basic)	**$159.00**
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QUALITY EXPANSION BOARDS DESIGNED SPECIFICALLY FOR KIM-1, SYM-1 & AIM 65

These boards are set up for use with a regulated power supply such as the one below, but, provisions have been made so that you can add onboard regulators for use with an unregulated power supply. But, because of unreliability, we do not recommend the use of onboard regulators. All I.C.'s are socketed for ease of maintenance. *All boards carry full 90-day warranty.*

All products that we manufacture are designed to meet or exceed industrial standards. All components are first qualtiy and meet full manufacturer's specifications. All this and an extended burn-in is done to reduce the normal percentage of field failures by up to 75%. To you, this means the chance of inconvenience and lost time due to a failure is very rare; but, if it should happen, we guarantee a turn-around time of less than forty-eight hours for repair.

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VAK-1 8-SLOT MOTHERBOARD

This motherboard uses the KIM-4* bus structure. It provides eight (8) expansion board sockets with rigid card cage. Separate jacks for audio cassette, TTY and power supply are provided. Fully buffered bus.

VAK-1 Motherboard	**$129.00**

VAK-2/4 16K STATIC RAM BOARD

This board using 2114 RAMs is configured in two (2) separately addressable 8K blocks with individual write-protect switches.

VAK-2 16K RAM Board with only 8K of RAM (½ populated)	**$239.00**
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VAK-5 2708 EPROM PROGRAMMER

This board requires a +5 VDC and ±12 VDC, but has a DC to DC multiplyer so there is no need for an additional power supply. All software is resident in on-board ROM, and has a zero-insertion socket.

VAK-5 2708 EPROM Programmer	**$269.00**

VAK-6 EPROM BOARD

This board will hold 8K of 2708 or 2758, or 16K of 2716 or 2516 EPROMs. *EPROMs not included.*

VAK-6 EPROM Board	**$129.00**

VAK-7 COMPLETE FLOPPY-DISK SYSTEM (May '79)

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This board allows you to create your own interfaces to plug into the motherboard. Etched circuitry is provided for regulators, address and data bus drivers; with a large area for either wire-wrapped or soldered IC circuitry.

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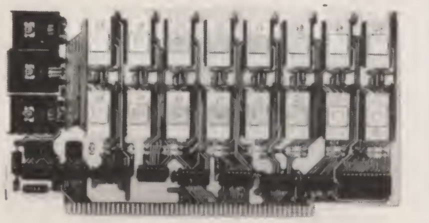

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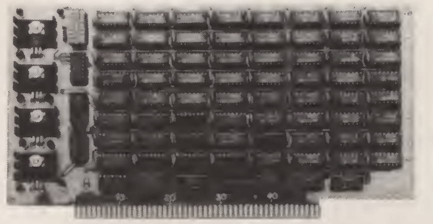

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KIT FEATURES:

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2. All sockets included.
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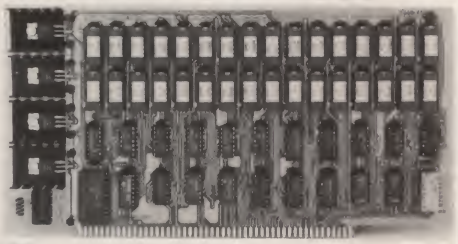
$295 KIT



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WHY THE 2114 RAM CHIP?

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6. All address and data lines fully buffered.
7. Kit includes ALL parts and sockets.
8. PHANTOM is jumpered to PIN 67.
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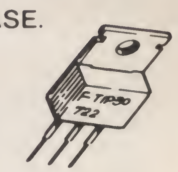

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